Defence Research and Development Canada — Recherche et développement pour la défense Canada

DEFENCE — DÉFENSE

Helicopter Maritime Environment Trainer: Maintenance Manual

Edited by:

Leo Boutette

Ken Ueno

Jason Dielschneider

This manual represents the operation of the HelMET System as originally installed with hardware updates to the current date. For current system start-up procedures consult the Helicopter Maritime Environment Trainer (HelMET) Start-Up, Virtual Lesson Plan (VLP) Editor & Shutdown Manual Application Version 4.0. For current Operational Procedures consult the Helmet 4 4 IOS User's Guide _Rev_011.

Defence R&D Canada

Technical Memorandum

DRDC Toronto TM 2011-049

June 2011

Canada

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This document is a revision of DRDC Toronto Document: CR2002-028 Atlantis Document: ED997-00369 titled Helicopter Maritime Environment Trainer: Maintenance Manual with updates to Version 4.4 of the HelMET software.

Abstract

The Helicopter Maritime Environment Trainer (HelMET) was developed by Defence R&D Canada – Toronto (DRDC Toronto) for training helicopter pilots to land on the flight deck of a Canadian Patrol Frigate (CPF) in a virtual environment. The HelMET was installed at 12 Wing, Canadian Forces Base (CFB) Shearwater, Nova Scotia, Canada [reference: Summary per document cited in next paragraph].

DRDC Toronto Document: CR2002-028 Atlantis Document: ED997-00369 titled Helicopter Maritime Environment Trainer: Maintenance Manual documented Version 1.1 of the HelMET System.

As third party support for the HelMET system did not come to fruition, DRDC Toronto has been supporting the HelMET system at 12th Wing Shearwater with hardware and software updates. The current version of HelMET is Version 4.4. Many of the updates implemented were made to allow the simulator to be used as a procedures trainer.

This document is a revision of CR2002-028 updated to reflect the large number of changes that have been implemented by DRDC Toronto since version 1.1. The purpose of this document is to update the description so that the system can be maintained and operated by Director Aerospace Development Program Management, Radar and Communications Systems or its representatives.

Résumé

Le Simulateur d’entraînement virtuel pour hélicoptère maritime (HelMET) a été développé par Recherche et développement pour la défense Canada – Toronto (RDDC Toronto) afin d’entraîner les pilotes d’hélicoptère à l’atterrissage sur le pont d’envol d’une frégate canadienne de patrouille dans un environnement virtuel. Le système HelMET a été installé à la 12e Escadre, Base des Forces canadiennes Shearwater, Nouvelle-Écosse, Canada [référence : sommaire par document cité dans le paragraphe suivant].

Document RDDC Toronto : CR2002-028, document Atlantis : ED997-00369 intitulé Simulateur d’entraînement virtuel pour hélicoptère maritime : Manuel d’entretien, documentation de la version 1.1 du logiciel HelMET.

Étant donné que la prise en charge du système HelMET par un tiers ne s’est pas réalisée, c’est RDDC Toronto qui en assure, par conséquent, le soutien à la 12e Escadre Shearwater au moyen de mises à niveau de matériel et de mises à jour de logiciel. La dernière version du logiciel HelMET est la version 4.4. De nombreuses fonctionnalités qui ont été implémentées visaient à permettre au simulateur d’être utilisé comme système d’entraînement aux procédures.

Le présent document est une révision du document CR2002-028 dont la mise à jour vise à refléter le grand nombre de modifications apportées au logiciel par RDDC Toronto depuis la version 1.1. L'objectif de ce document est de mettre à jour les descriptions de façon à ce que le système puisse être maintenu et utilisé par le Directeur – Gestion du programme de développement aérospatial (système de radar et de communication) ou ses représentants.

Executive summary

Helicopter Maritime Environment Trainer: Maintenance Manual:

Leo Boutette; DRDC Toronto TM 2011-049; Defence R&D Canada – Toronto; June 2011.

Introduction or background: The Helicopter Maritime Environment Trainer (HelMET) was developed by Defence R&D Canada – Toronto (DRDC Toronto) for training helicopter pilots to land on the flight deck of a Canadian Patrol Frigate (CPF) in a virtual environment. The HelMET was installed at 12 Wing, Canadian Forces Base (CFB) Shearwater, Nova Scotia, Canada [reference: Summary per document cited in next paragraph].

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Sommaire

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Leo Boutette; DRDC Toronto TM 2011-049; R & D pour la défense Canada – Toronto; Juin 2011.

Le Simulateur d’entraînement virtuel pour hélicoptère maritime (HelMET) a été développé par Recherche et développement pour la défense Canada – Toronto (RDDC Toronto) afin d’entraîner les pilotes d’hélicoptère à l’atterrissage sur le pont d’envol d’une frégate canadienne de patrouille dans un environnement virtuel. Le système HelMET a été installé à la 12e Escadre, Base des Forces canadiennes Shearwater, Nouvelle-Écosse, Canada [référence : sommaire par document cité dans le paragraphe suivant].

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SYSTEM USAGE WARNING

AT THE REQUEST OF THE CANADIAN FORCES (CF), DRDC TORONTO CONSTRUCTED A LOW COST EXPLORATORY DEVELOPMENT SIMULATOR FOR SEA KING HELICOPTER DECK LANDING (HDLS). THE HDLS WAS VALIDATED IN AN EXPERIMENTAL INTER-SIMULATOR TRANSFER OF TRAINING STUDY.
BASED ON THE RESULTS AND FAVOURABLE COMMENTS FROM EXPERIENCED SEA KING PILOTS, CF REQUESTED THE PRODUCTION OF A SIMULATOR TO “DEMONSTRATE TO THE MARTIME HELICOPTER COMMUNITY THE CAPABILITIES OF THE SIMULATOR AND GET THEM INVOLVED IN THE PROCESS OF DEVELOPING THE STRETCH POTENTIAL OF THIS TECHNOLOGY". WITH THE ASSISTANCE OF PILOTS, THE HDLS WAS RE-CONFIGURED (HelMET, PILOT/IOS OPERATOR) TO DIRECTLY EVALUATE TRANSFER OF TRAINING IN SHEARWATER. THE DESIGN FOCUS WAS TO PROVIDE A HELICOPTER MARITIME ENVIRONMENT TRAINER (HelMET) CAPABLE OF THREE OPERATION SEQUENCES (DAYTIME LAND/LAUNCH FREE DECK & HAUL DOWN, AND NIGHT TIME FREE DECK OPERATIONS) AS DERIVED FROM SHIPBORNE HELICOPTER OPERATIONS PROCEDURES (SHOPS).

AT THE SUGGESTION OF 12 WING, ISSUES SUCH AS THE CONSTRUCTION OF A BARRIER AROUND THE MOTION BASE AND PLATFORM, WERE EXPLORED BY THE PILOTING COMMUNITY AFTER THE INSTALLATION IN SHEARWATER. CAUTION SHOULD ALWAYS BE EXERCISED IN THE USE OF THE SIMULATOR CONSISTENT WITH ITS PLANNED USAGE. THESE CAUTIONS INCLUDE CARE IN THE MOUNTING OF THE MOTION PLATFORM, ATTENTION TO THE OPERATIONS SEQUENCES OF POWERING THE MOTION PLATFORM, KEEPING ALL PERSONNEL AT AN ADEQUATE DISTANCE FROM THE PLATFORM DURING ITS OPERATION, AND NOT USING THE PLATFORM OUTSIDE OF ITS DESIGN LIMITS.

WARNING

THE MOTION BASE IS IN A 'PARKED POSITION' WHEN THE SIMULATOR IS NOT IN USE. AS THE SIMULATOR IS ACTIVATED, THE MOTION BASE IS RAISED FROM ITS PARKED POSITION TO A NEUTRAL POSITION, BUT DOES NOT BEGIN TO MOVE UNTIL THE IOS OPERATOR STARTS THE MOTION BASE BY PRESSING THE 'START' BUTTON ON THE IOS OPERATOR GRAPHIC USER INTERFACE. THE NORMAL METHOD FOR SHUTTING DOWN THE MOTION BASE IS THE IOS OPERATOR BRINGS THE MOTION BASE TO A NEUTRAL AND THEN PARKED POSITION, ACCORDING TO THE PROCEDURES IN SECTION 4 ON SIMULATOR OPERATING PROCEDURES IN THE OPERATOR MANUAL.

APART FROM THE NORMAL PROCEDURE FOR STOPPING THE MOTION BASE, FOUR SWITCHES ARE AVAILABLE TO DIS-ENGAGE THE MOTION BASE: AN EMERGENCY BUTTON LOCATED ON THE ELECTRICAL POWER CONTROL PANEL, A SWITCH ON THE MOTION PLATFORM CONTROL COMPUTER, A STOP BUTTON AT THE IOS OPERATOR CONSOLE, AND A SWITCH (TRIGGER) ON THE COLLECTIVE PITCH LEVER AVAILABLE TO THE PILOT. WE DO NOT RECOMMEND THE SWITCH (TRIGGER) ON THE COLLECTIVE PITCH LEVER FOR ROUTINE USE. HOWEVER, SHOULD THE PILOT NEED TO DIS-ENGAGE THE MOTION BASE IN AN EMERGENCY, THE SWITCH (TRIGGER) SHOULD BE PULLED AND HELD IN POSITION FOR APPROXIMATELY 3 TO 5 SECONDS. THE IOS OPERATOR WILL THEN NEED TO BE CALLED FOR AN ORDERLY SHUTDOWN. THE STUDENT/PILOT WILL NEED TO CONTINUE HOLDING THE TRIGGER UNTIL THE IOS OPERATOR REPORTS THE PLATFORM PARKED. **NOTE:** THE TRIGGER ONLY STOPS PLATFORM MOTION WHEN HELD IN POSITION. IF THE TRIGGER IS RELEASED PRIOR TO PARKING, THE PLATFORM WILL RESUME MOVING.

WARNING

THE VOLTAGES EMPLOYED IN THIS EQUIPMENT ARE SUFFICIENTLY HIGH TO ENDANGER HUMAN LIFE. A RESONABLE PRECAUTION HAS BEEN OBSERVED IN DESIGN TO SAFEGUARD THE OPERATING PERSONNEL. OPERATING PERSONNEL SHOULD BE PROHIBITED FROM TAMPERING WITH PROTECTIVE DEVICES SUCH AS MOTION SWITCHES, POWER CONTROL PANEL, AND EMERGENCY BUTTONS. THE POWER SHOULD BE REMOVED COMPLETELY AND THE HIGH-VOLTAGE CAPACITORS IN POWER SUPPLIES DISCHARGED WITH THE AID OF A SHORTING BAR BEFORE MAKING ANY INTERNAL ADJUSTMENTS.

SAFETY SUMMARY

The following are general safety precautions that are not related to any specific procedures and therefore do not appear elsewhere in this publication. These are recommended precautions that personnel must understand and apply during many phases of operation and maintenance.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must at all times observe all safety regulations. Do not replace components or make adjustments inside the equipment with the high voltage supply turned on. Under certain conditions, dangerous potentials may exist when the power control is in the off position, due to the charges retained by capacitors. To avoid casualties always remove power and discharge and ground a circuit before touching it.

DO NOT SERVICE OR ADJUST ALONE

Under no circumstances should any person reach into or enter the enclosure for the purpose of servicing or adjusting except in the presence of someone who is capable of rendering aid.

RESUSCITATION

Personnel working with or near high voltages should be familiar with modern methods of first aid and resuscitation.

NOTES TO USERS

WARNING, CAUTION, and NOTE data are defined in the following manner:

WARNING
To emphasize operating procedures, practices, etc., which, if not correctly followed, could result in personal injury or loss of life.

CAUTION
To emphasize operating procedures, practices, etc., which, if not correctly followed, could result in damage to or destruction of equipment.

NOTE
To highlight a procedure, event or practice that is desirable or essential.

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1 Introduction

1.1 Purpose of the Helicopter Maritime Environment Trainer

The Helicopter Maritime Environment Trainer (HelMET), herein referred to as the simulator, Helicopter Deck Landing Simulator (HDLS), or Virtual Reconfigurable Simulator (VR-Sim), or Reconfigurable Helicopter Simulator (RHS), is designed to provide comprehensive initial and refresher training in a virtual environment for pilots of the Sea King helicopter in landing on the flight deck of a Canadian Patrol Frigate (CPF). Use of the simulator provides for effective training and evaluation while minimizing the high cost of operating ship and aircraft for training missions and eliminating the inherent danger of personal injury and/or damage to aircraft and/or ship.

1.2 Use of the Maintenance Manual

This Maintenance Manual (MM) has been prepared to aid maintenance operators in the effective maintenance of the simulator. It provides maintenance operators with all the data necessary to prepare and conduct system tests, and preventive and corrective maintenance. Personnel who will perform preventive and corrective maintenance on the simulator should read this manual thoroughly to understand the purpose, capabilities, limitations, and procedures for effective maintenance of the simulator.

1.3 Document Overview

This document describes the preventive and corrective maintenance procedures to be used for the simulator. A brief outline of the contents of this document is given below:

Section 1 – Introduction

This section contains the introduction, which describes the purpose of the simulator equipment and the intended use of this maintenance manual.

Section 2 – Referenced Documents

This section lists by document number, title, revision, and date all documents referenced in this manual.

Section 3 – General Description

This section provides system and unit descriptions.

Section 4 – Maintenance

This section describes test procedures, and preventive and corrective maintenance procedures.

Section 5 – Support and Test Equipment

This section provides a list of support and test equipment.

Section 6 – Jumpers and Switches Settings

This section contains jumpers and switches settings, and Ethernet addresses that are specific to the simulator configuration.

Section 7 - Notes

This section contains general information.

Insofar as possible, technical terminology has been avoided in the preparation of this manual. Emphasis has been placed on clarity and accuracy of presentation.

2 Referenced Documents

The following government and non-government documents are referenced in this manual:

a.	DRDC Toronto Specification	Helicopter Deck Landing Simulator & Landing Signalling Officer Simulator Preliminary Specification (Updated)
b.	DRDC Toronto Technical Report	Helicopter Deck Landing Simulator: Technology Demonstrator by F.A. Lue And L.E. Magee
c.	DRDC Toronto/12 Wing	Operational Sequence Diagram (OSD): Daytime Freedeck Launch
d.	DRDC Toronto/12 Wing	Operational Sequence Diagram (OSD):Night-Time Freedeck Recovery
e.	DRDC Toronto/12 Wing	Operational Sequence Diagram (OSD): Daytime Hauldown Recovery
f.	C-12-124-A00/MB-000	Aircraft Operating Instructions, CH124 Sea King Helicopter, 2000
g.	CFTO B-06-282-000/FP-000	Shipborne Helicopter Operating Procedures (SHOP)
h.	DRDC Toronto Document:CR 2002-022	Helicopter Maritime Environment Trainer Operator Manual
i.	DRDC Toronto Document:CR 2002-027	Helicopter Maritime Environment Trainer Software Test Document
j.	DRDC Toronto TrainerDocument:CR 2002-031	Helicopter Maritime Environment Version Description Document
k.	Servos and Simulation, Inc.	Six Degree of Freedom Motion Platform, Maintenance Document, October 1997
l.	BG Systems, Inc.	CerealBox Hardware Manual, 4.02, November 1998
m.	BG Systems, Inc.	LV824 Software Manual, 4.03, June 1999
n.	Polhemus Inc.	3SPACE FASTRAK User’s Manual, Revision F, November, 1993

o.	NVIS, Inc.	NVISION SX User Guide,
p.	Yamaha	DEQ7 Digital Equalizer Operating Manual
q.	BSS Audio Ltd.	FDS 360 User’s Manual
r.	Carver	TFM-6C High-Headroom/Low Feedback Power Amplifier Owner’s Manual
s.	Clark Synthesis Tactile Sound	Installation and Operation Guide (229, 329, 3710 & Platinum)
t.	Silicon Graphics Inc.	Color Graphic Monitor GDM-4011P Operating Instructions
u.	Silicon Graphics Inc.	Color Monitor D-M21G (CM2198MSG) User’s Manual
v.	Sony Corporation	Trinitron Color Graphic Display Multiscan 17se Operating Instructions
w.	Dell	Dell Dimension 4100 System Reference
x.	Dell	Dell UltraScan P991 Color Monitor Quick Setup
y.	EMS	G5 Series Instruction Manual
z.	American Power Conversion	Matrix UPS User’s Manual
aa.	Mackie	1202-VLZ PRO 12 Channel Mic/Line Mixer
bb.	Virtual Research	VR1280 Owner’s Manual
cc.	Tyan	B4985 Transport FT48 Service Engineers Manual Barebone System
dd.	Tyan	S4985 Thunder n4250QE User's Manual
ee.	Dell	Dell Precision 650 User’s Guide
ff.	Dell	Dell Precision 650 Service Manual
gg.	Dell	Dell Precision 530 User’s Guide
hh.	Dell	Dell Precision 530 Service Manual

3 System Description

3.1 Simulator General Description

The HelMET was developed by Defence R&D Canada - Toronto (DRDC Toronto) to train helicopter pilots to land on the flight deck of a Canadian Patrol Frigate (CPF) in a virtual environment.

The HelMET was installed at 12 Wing, Canadian Forces Base (CFB) Shearwater, Nova Scotia, Canada.

The simulator consists of the following major areas, as illustrated in

Figure 1:

- Administration Station
- Low Frequency Station
- Instructor Operator Station
- Trainee Pilot Station
- Second Pilot Station
- Landing Signals Officer (LSO) Station
- Equipment Rack Station2
- Motion Platform Power Station
- Equipment Rack Station1
- Medium Frequency Station
- Audio Communication Subsystem Station

The Administration Station provides the computing facilities for simulations and controls.

The Low Frequency Station houses two low frequency loudspeakers.

The Instructor Operator Station (IOS) provides the IOS operator with the necessary controls and displays to effectively control, monitor, communicate, and evaluate a helicopter decking landing training exercise.

The Trainee Pilot Station provides a crew station for the pilot to be trained in a virtual environment. The station is equipped with a head-mounted display (HMD) with headset, pilot seat, cyclic pitch stick, collective pitch lever and tail rotor pedals housed on an electric motion base.

The Second Pilot Station provides a crew station for the pilot to assist in training a trainee pilot in a virtual environment. The station is equipped with a head-mounted display (HMD) with headset, pilot seat, and controls for the landing gear.

The Landing Signals Officer (LSO) Station provides a crew station for an operator to act as the LSO while training a pilot in a virtual environment. The station is equipped with a head-mounted display (HMD) with headset and a mockup of the LSO console including active switches and levers.

The Equipment Rack Station2 houses video distribution equipment.

The Motion Platform Power Station provides power supply and power control equipment for the Motion Platform Subsystem.

The Equipment Rack Station1 houses the Motion Platform Control Computer, voice mixer, and sound generation equipment.

The Medium Frequency Station houses two medium frequency loudspeakers on a stand.

The Audio Communication Subsystem Station provides the necessary facilities for the IOS operator and the pilot trainee to exchange audio communications during a training exercise.

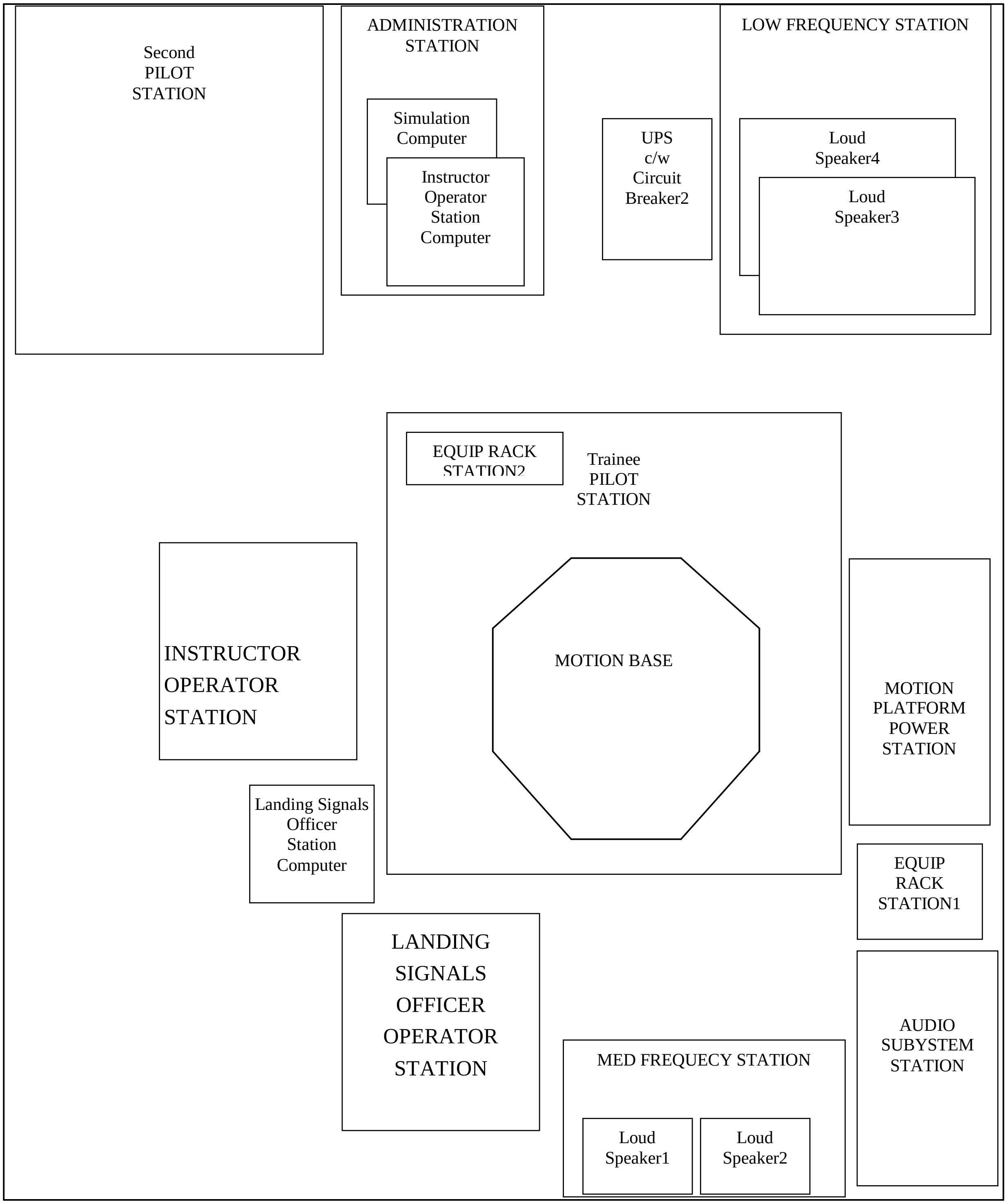

Figure 1 Simulator Floor Plan

3.2 System Overview

3.2.1 Background

Currently, Canadian Forces (CF) pilots flying the Sea King helicopter learn to land on the flight deck of a CPF through practice at sea. Although the training community has used a Sea King helicopter simulator at CFB Shearwater for more than thirty years, it does not have a visual display and, consequently, cannot be used for training visually guided tasks. Modern simulators are available with non-HUD visual displays, but they are expensive to procure and maintain. The acquisition cost of a typical commercial simulator can exceed $20 million Canadian. Although expensive, high-end simulators are cost-effective for some training operations when the high costs and risks associated with operational training are considered. However, the large acquisition price, the high maintenance costs, the small maritime pilot population, and limited Sea King lifespan, as well as geographical considerations, are likely factors that dissuade the purchase of high-end simulators for training deck landing skills.

In 1994, DRDC Toronto was requested by CF to investigate the potential use of low cost, virtual reality technologies for this purpose, following a successful demonstration of these technologies for training ship handling skills and reductions of sea time.

Landing on the deck of a CPF in high sea states is considered one of the most challenging visually guided tasks performed by any helicopter pilot in the CF. It requires fine motor skills, exceptional judgement, and precise manoeuvring techniques. Moreover, good depth perception is an essential element and a necessity for this task as the helicopter blades are within 5 metres of the ship's hangar face in the properly landed position. The physics-based modelling aspects are also formidable challenges, since, in addition to the aerodynamic modelling of the Sea King, the modelling of the ship's dynamics, interactions with the wind as affected by the ship's superstructure, as well as modelling of the undercarriage and its contact with the deck surface, must be included.

The simulator design goals are to include affordability, portability, modularity, and low maintenance. Low cost can be partially achieved by employing commercial off-the-shelf (COTS) components intended for the entertainment market, rather than components specialized for high-end simulators.

A detailed description of the HelMET/HDLS development can be found in [References a, b].

3.2.2 Simulator System Description

The simulator design builds on common COTS components supplemented with specific aircraft parts from the Sea King helicopter. The Pilot Station includes an adjustable Sea King seat and primary flight control equipment that is linked to the Simulation Computer Subsystem and other various subsystems for sensory cueing. The Simulation Computer Subsystem, flight control components, and other subsystems are further discussed, along with their general characteristics. The pilot's flight controls, including tail rotor pedals, collective pitch lever, and cyclic pitch stick, were obtained from the CF supply system or were built from technical drawings. Sensory cues are provided by a visual subsystem, motion platform subsystem, and sound and vibration subsystems. Control of pilot training is conducted via the Instructor Operator Station and Audio Communication Subsystem.

The simulator system block diagram is shown in

Figure 2. The simulator consists of the following major subsystems [References a, b]:

- Motion Platform Subsystem
- Flight Control Component Subsystem
- Visual Subsystem
- Video Distribution Subsystem
- Sound Subsystem
- Vibration Subsystem
- Audio Communication Subsystem
- Simulation Computer Subsystem
- Instructor Operator Station Subsystem
- Landing Signals Officer Station Subsystem
- Local Area Network.

The Motion Platform Subsystem, a six-degree of freedom (DOF) motion base unit, provides the necessary motion cues (roll, pitch, yaw, heave, surge, and sway) for a simulated helicopter.

The Flight Control Component Subsystem provides user control interfaces to three unique flight control characteristics: the vertical control, the horizontal control, and the heading control.

The Visual Subsystem provides the pilots with a view of the simulated environment. It consists of head tracking devices, an image generator, and head-mounted displays. The head tracking devices determines the position and orientation of the pilots' heads, which is used to determine his/her point of view. These measurements are passed to the image generator that renders the images within this field of view (FOV) and transmits the images to the Video Distribution Subsystem.

The Video Distribution Subsystem accepts display images in SVGA video signals from the image generator and distributes images to the HMD displays for pilots viewing, the IOS display repeater for instructor viewing, and the projector screen for presentation to a larger audience.

The Sound Subsystem drives the sound and vibration subsystems' speakers and delivers continuous auditory cues as a function of the Sea King's simulated flight regime based on data received from the Simulation Computer Subsystem.

Similar to the Sound Subsystem, the Vibration Subsystem provides continuous cues to supplement the Motion Platform Subsystem. The Vibration Subsystem provides the higher frequency vibration environments that are not normally provided through the Motion Platform Subsystem.

The Audio Communication Subsystem provides the necessary audio communication interfaces between the pilot and IOS operator.

The Simulation Computer Subsystem executes the helicopter simulation model and management utilities, uses the pilot's controls to calculate the motion dynamics, determines the pilot's point of view from tracking head movements, and generates the graphics for the pilot's visual display and the IOS repeater monitors.

The Instructor Operator Station communicates with the Simulation Computer Subsystem for the simulation control.

The Landing Signals Officer Station communicates with the Simulation Computer Subsystem for the simulation status and provides the Landing Signals office with visual represenation of the virtual scene. It also accepts input via the LSO console and provides this data to the simulation computer to update the simulation.

The Simulation Local Area Network provides communication among the six major computers (Motion Platform Control Computer, Simulation Computer, IOS Computer, LSO computer, Audio Communication Subsystem Computer 1 – Digital Audio Conferencing and Audio Communication Subsystem Computer 2 – Digital Audio Conferencing & Effects) that host the applications software for the simulation.

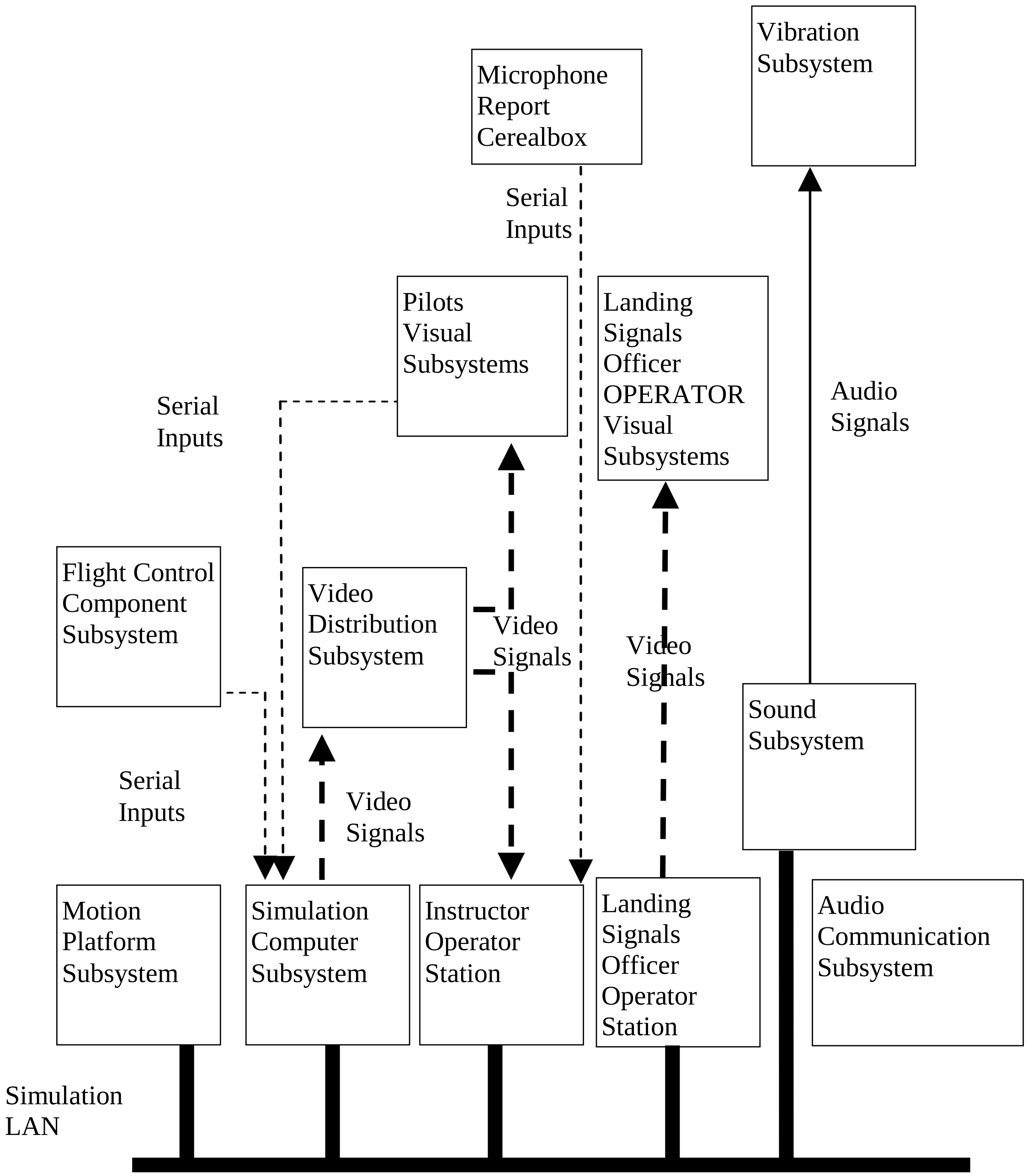

Figure 2 Simulator System Block Diagram

3.2.3 Hardware Configuration Items

The simulator consists of the following major Hardware Configuration Items (HWCIs):

- Motion Platform Subsystem
- Flight Control Component Subsystem
- Visual Subsystem
- Video Distribution Subsystem
- Sound Subsystem
- Vibration Subsystem
- Audio Communication Subsystem
- Simulation Computer Subsystem
- Instructor Operator Station Subsystem
- Landing Signals Officer Station Subsystem
- Local Area Network.

3.2.3.1 Motion Platform Subsystem

The Motion Platform Subsystem, a six DOF motion base unit from Servos and Simulation, Inc., provides the necessary motions (roll, pitch, yaw, heave, surge, and sway) for a simulated helicopter platform. It consists of the following major components:

- Power Supply Switch Box
- Power Control Panel
- Motion Platform Base Assembly
- Motion Platform Control Computer.

Table 1 provides a summary of the dynamic, mechanical, and electrical specifications.

Table 1 Motion Platform Dynamic, Mechanical, and Electrical Specifications

Item	Description
Dynamic:	

Item	Description
Limit of Motion (Roll) +/	18º
Limit of Motion (Pitch) +/	18º
Limit of Motion (Yaw) +/	18º
Limit of Motion (Heave) +/	0.114 m (+/
Limit of Motion (Surge)+/	0.127 m (+/
Limit of Motion (Sway) +/	0.127 m (+/
Limit of Velocity (Roll) +/	60º per second
Limit of Velocity (Pitch) +/	60º per second
Limit of Velocity (Yaw)+/	60º per second
Limit of Velocity (Heave) +/	0.762 m/sec (+/
Limit of Velocity (Surge) +/	0.762 m/sec (+/
Limit of Velocity (Sway) +/	0.762 m/sec (+/
Limit of Acceleration (Roll) +/	140º per sec per sec
Limit of Acceleration (Pitch) +/	140º per sec per sec
Limit of Acceleration (Yaw)	+/- 140º per sec per sec
Limit of Acceleration (Heave)	1.0 g
Limit of Acceleration (Surge)	1.0 g
Limit of Acceleration (Sway)	1.0 g

Item	Description
Mechanical:	
Payload Weight	908 kg (2,000 lb)
Payload Centre of Gravity	Centred on the Motion Frame
Motion Frame Standard Dimensions	Rectangle 0.635 m x 0.914 m (26 in x 36 in)
Floor Frame Standard Dimensions	2.134 m (84 in) circular footprint
Standard Height	0.787 m (31 in) to the top of the motion frame
Standard Weight	908 kg (2,000 lb)
Electrical:	
Standard Analog Input	6 signals, +/- 7.5 VDC each
Motors	Six 5 HP AC motors
Electrical Power	220 VAC, 50/60 Hz, 3 Phase, 90 amps
Connectors	Industrial quality connector furnished

3.2.3.1.1 Power Supply Switch Box

The Power Supply Switch Box from the installation facility provides 220 VAC, 50/60 Hz, three-phase power to the Motion Platform Subsystem.

3.2.3.1.2 Power Control Panel

The Power Control Panel (also known as the Electrical Power Distribution and Control Enclosures), a 0.92 m wide x 0.76 m high x 0.20 m deep NEMA type 12 unit, provides the necessary electrical power supplies to the Motion Platform Control Computer and Motion Platform Base Assembly. Single-phase 115 VAC is used to power the Motion Platform Control Computer while three-phase 220 VAC is provided to power each of the six EMS motor drives. A 5 VDC power supply is used to power the Platform Table Assembly for the helicopter flight control components.

Each of the EMS motor drives is powered by a 15 Amp, three-phase circuit breaker and a solid state relay is located between the EMS motor drive and the circuit breaker such that electrical power to the Motion Platform Assembly may be remotely controlled by the Motion Platform Control Computer and four Power Off switches. Emergency stopping of the motion platform is available at two physical locations: the Motion Platform Power Control Panel location and the Motion Platform Control Computer System location. A Stop button is located at the Instructor Operator Station.

3.2.3.1.3 Motion Platform Base Assembly

The Motion Platform Base Assembly is composed of the top assembly, three leg assemblies, three leg assembly equipment covers, and three floor-mounting brackets that comprise the lower portion of the motion platform. The rectangular top assembly is used to house the Platform Table Assembly for the flight control components. The three leg assemblies are mechanically identical and differ only in AC power and signal distribution. Each of the leg assemblies contains two motor/gearbox assemblies, two EMS motor drives, two angular displacement transducer position sensors, two sets of pushrods, and four capacitors used for energy storage. The motion platform is connected to the floor by three floor-anchoring brackets.

3.2.3.1.4 Motion Platform Control Computer

The Motion Platform Control Computer consists of the following major components:

- Motion Platform Computer
- Motion Platform Display Monitor
- Motion Platform Keyboard.

The Motion Platform Computer, an Advantech IPC-610 computer, is a 19 inch rack-mounted computer chassis for industrial applications with a 14-slot ISA or ISA/PCI backplane for the central processing unit (CPU), and input and output boards. It is used to control the six degrees of freedom motion platform.

A summary of physical and environmental specifications of the Motion Platform Computer is shown in Table 2. The computer is equipped with the following standard computer peripherals:

- A 100 MHz Pentium Single Board Computer (SBC) mounted in slot 1 of the passive backplane chassis
- A 8 Mbytes Flash Disk
- One 3.5 inch Hard Disk Drive and one 3.5 inch Floppy Disk Drive
- One VGA Display Monitor
- One standard keyboard
- One RS-232 serial port
- One Centronics parallel port
- One CIO-DDA06/12 Digital I/O board for communicating with the SBC
- One CIO-RELAY08 Relay board.

The CIO-DDA06/12 Digital I/O board from Computer Boards, Inc. is a 12-bit digital-to-analogue converter (DAC) card that is used to convert digital data into analogue signals that drive each of the six legs on the motion platform. The CIO-RELAY08 Relay board from Computer Boards, Inc. provides eight relays in 8 Form C contact sets.

The Motion Platform Display Monitor, model TTX-3402, is a standard 14 inch display monitor for PC applications. The Motion Platform Keyboard is a standard PC keyboard.

Table 2 Advantech IPC-610 Physical and Environmental Specification

Item	Description
Computer - Width	0.482 m
Computer - Height	0.177 m
Computer - Depth	0.452 m
Weight	17.5 kg

Item	Description
Colour	PANTONE 414U
Construction	Heavy-duty steel
0º C to 50º C Cooling Fans	One 86 CFM cooling fan with air filtersOperating Temperature
Relative Humidity	5 to 95 %, non-condensing

3.2.3.2 Flight Control Component Subsystem

The Flight Control Component Subsystem provides interfaces to simulate three unique flight control characteristics: the vertical control, the horizontal control, and the heading control. It consists of the following major items:

- Platform Table Assembly
- Collective Pitch Lever
- Cyclic Pitch Stick
- Tail Rotor Pedals
- Pilot Seat
- Flight Control CerealBox.

3.2.3.2.1 Platform Table Assembly

The Platform Table Assembly, approximately 1.4 m (long) by 0.9 m (wide), is a DRDC-designed plate assembly to house the Primary Flight Control Component Subsystem equipment and various positioning devices.

NOTE

With electrical power removed, the moveable platform remains in position largely due to the capacitors and the friction of the spherical bearings on the adjoining links. Once the capacitors are discharged, if sufficient forces are imposed to overcome this friction, the platform will move towards its parked position. If the platform power is lost and the platform is not in its parked position, stepping on it will likely cause it to move and become unstable. Therefore, if power is removed, ensure that the platform is moved to its parked position before mounting or dismounting the moveable platform.

3.2.3.2.2 Collective Pitch Lever

The main rotor flight controls provide both vertical and directional control. The collective pitch lever located on the left side of the pilot seat is the primary vertical control for the main rotor. Vertical control is accomplished by changing collectively the pitch (angle of incidence) of the main rotor blades. This increases or decreases the angle of attack of all the blades simultaneously and, consequently, the tilt or vertical thrust developed.

WARNING

Emergency momentarily stopping of the platform motion is available on the pilot's collective pitch lever as a switch. To stop the platform movement with this switch, press and hold the collective pitch lever switch for more than 3 seconds. Note that the activation of this switch will only remove the platform motion entirely if held. As soon as the switch is released, the platform will be in motion. Since this switch must be held to keep the motion platform inactive, it is preferred that operationally the Stop button on the Instructor Operator Station be used.

The preferred method of removing the platform motor drive power is to use the Stop button on the Instructor Operator Station or, if necessary, the Emergency Stop button located on the Electrical Power Control Panel.

3.2.3.2.3 Cyclic Pitch Stick

The cyclic pitch stick located in front of the pilot seat is the primary horizontal control for the main rotor. Directional control is accomplished by tilting the main rotor that produces a directional thrust in that direction. The rotor is tilted by changing the pitch of each blade individually as it makes a complete rotation. The cyclic pitch change causes the blade to climb or dive as it rotates, causing the vertical axis to tilt in the desired direction.

NOTE

The cyclic’s Trim Release button does not function in the same manner as on the actual Sea King, CH124. The cyclic’s Trim Release button on the Pilot Station resets the sum of the trim inputs, as commanded by the pilot, since the start of the session. Thus pressing the Trim Release button will return the synthetic trim to the state that it was when the mission commenced. The parameters selected, at the start of a session, for ambient wind will affect the initial position (or datum) referenced by the synthetic trim.

3.2.3.2.4 Tail Rotor Pedals

The tail rotor pedals are located on the Pilot Station Platform Table Assembly in front of the pilot seat. The tail rotor pedals change the pitch and thrust of the tail rotor and, consequently, the heading of the helicopter. Pressing the left-hand pedal increases the tail rotor blade pitch, which increases thrust, and turns the helicopter to the left. Pressing the right-hand pedal decreases the tail rotor blade pitch, which decreases thrust, and turns the helicopter to the right.

3.2.3.2.5 Pilot Seat

The pilot seat is mounted on rails that allow adjustment fore and aft. It includes seat height adjustment and a four-point safety restraint harness as well as a five-point emergency backpack that is used for padding.

3.2.3.3 Flight Control CerealBox

The Flight Control CerealBox unit provides the necessary interfaces to the collective pitch lever, cyclic stick grip, and tail rotor pedals. The pilot's helicopter control inputs are digitally transmitted to the Simulation Computer on serial I/O connections. The interface unit is an analogue-to-digital and serial converter box, known as CerealBox from B. G. Systems. The CerealBox physical dimensions are 10 cm x 13 cm x 3 cm and the weight is 0.28 kg. The LV824 CerealBox is an eight analogue input, 24 digital input device that provides sampled data from analogue and digital devices and transfers sampled data to the serial (RS-232) port of the Simulation Computer Subsystem. The analogue input channels can be programmed individually for different input voltages (0 to +5, -5 to +5, 0 to +10, and –10 to +10 VDC). The CerealBox can support baud rates between 2,400 and 115,200.

3.2.3.4 Microphone Report Cerealbox

The Microphone report CerealBox unit provides the necessary interfaces to the microphone switches at both pilot positions. The pilot's microphone inputs are digitally transmitted to the Instructor Operator Computer on serial I/O connections. The interface unit is an analogue-to-digital and serial converter box, known as CerealBox from B. G. Systems. The CerealBox physical dimensions are 10 cm x 13 cm x 3 cm and the weight is 0.28 kg. The LV824 CerealBox is an eight analogue input, 24 digital input device that provides sampled data from analogue and digital devices and transfers sampled data to the serial (RS-232) port of the Instructor Operator Computer Subsystem. The analogue input channels can be programmed individually for different input voltages (0 to +5, -5 to +5, 0 to +10, and –10 to +10 VDC). The CerealBox can support baud rates between 2,400 and 115,200.

3.2.3.5 Visual Subsystem

The Visual Subsystem provides the pilot and co-pilot with a view of the simulated environment. It consists of the following major components:

- Head Tracking Device
- Image Generator
- Head Mounted Display (HMD).

The Head Tracking Device determines the position and orientation of the pilot's head and is used to determine his point of view. These measurements are passed to the Image Generator that renders the images within this field of view (FOV) and transmits the images to the Video Distribution Subsystem. The Video Distribution Subsystem distributes images to the Head Mounted Display for pilot viewing and the Instructor Operator Station for instructor viewing.

3.2.3.5.1 Head Tracking Device

The Head Tracking Device control inputs are digitally transmitted to the Simulation Computer on serial I/O connections. A six DOF head tracking device, Polhemus 3 SPACE FASTRAK II, is used to sense the pilot’s head position and orientation within a half-dome, electromagnetic field. It is based on generating near field, low frequency, magnetic field vectors from the transmitter that is a single assembly of three co-located, stationary antennas. The receiver, a single assembly of co-located, remote sensing antennas, detects the magnetic field vectors. The detected signals are input to a mathematical algorithm that computes the receiver’s position and orientation relative to the transmitter.

Table 3 provides a summary of the 3 SPACE FASTRAK II physical specifications. The 3 SPACE FASTRAK II consists of the following major components:

•System Electronics Unit (SEU)

•Transmitter

•Receiver

•Power Supply.

The SEU contains the hardware and software necessary to generate and sense the magnetic fields, compute position and orientation, and interface with the Simulation Computer via a serial RS-232 interface.

The transmitter is a triad of electromagnetic coils (enclosed in a plastic shell) that emits the magnetic fields. It is the system's reference frame for receiver measurements.

The receiver is a small triad of electromagnetic coils (enclosed in a plastic package) that detects the magnetic fields emitted by the transmitter. As the receiver moves with its attached cube, its position and orientation are precisely measured.

The 3 SPACE FASTRAK II can provide position and orientation with a static accuracy of about 0.08 cm RMS and a resolution of 0.0005 cm/cm at 4 ms latency (for a receiver/transmitter separation of less than 76.2 cm.). These data are transmitted to the Simulation Computer at a data rate of 38.4K baud and updated at 120 Hz for a single receiver configuration.

In the current simulator configuration, the transmitter is positioned above the pilot's head by two converging arches that project upward from the top of the pilot seat. The arches are made of wood to avoid electromagnetic interference. The receiver is mounted on the top of HMD. The processed receiver data are transmitted to the Image Generator via a RS-232 serial interface and used to determine the eye viewpoints for the computer-generated visual display.

Table 3 Polhemus 3 SPACE FASTRAK Physical Characteristics

Item	Description
SEU Dimensions	0.29 m (L) x 0.29 m (W) x 0.09 m (H)
SEU Weight	2.26 kg
Power Supply Dimensions	0.178 m (L) x 0.94 m (W) x 0.559 m (H)
Transmitter Dimensions	0.584 m (L) x 0.559 m (W) x 0.559 m (H)
Receiver Dimensions	0.229 m (L) x 0.279 m (W) x 0.152 m (H)
Operating Temperature	10º C to 40º C
Relative Humidity	10 % to 95 %
Power Requirements	25 W, 90-250 VAC, 38-65 Hz

3.2.3.5.2 Simulation/Image Generation Computer

The Image Generator generates the visual representations of the helicopter cockpit and exterior scene from a pilot's perspective. The visual representation of a simulated exterior scene includes the earth horizon, ocean surface, and several landmarks on the CPF platform rear deck as viewed from the pilot's seat through the windows of a Sea King helicopter.

The Pilot image generation is accomplished from the Simulation Computer, which is a Concurrent Imagen computer with 2 NVIDIA Quadro FX 5500 graphics cards. These graphics cards can each drive a stereo 1280 x 1024 Head mounted Display. The software rendering pipelines are each split into three major pieces to handle critical path operations for (i) specification of viewpoint and object positions, (ii) level of detail (LOD) management, view frustum culling, sorting, and (iii) the final rendering of the scene. The multi-threaded, parallel pipelines for per-frame scene management and image generation for graphics rendering drive the stereo projection images. The image generator affords a full field of regard, limited only by the visual representation of obstructions of the aircraft.

The Simulation Computer Subsystem (Concurrent Imagen) provides four independent graphical channels, one for each eye for each of the stereo HMDs.. It renders all components of the visual environment, including the sea surface and ship details. The scene refresh rate is non-interlaced. The scenes are constructed from coloured, textured polygons. About 6,000 to 8,000 polygons compose each scene. The run-time and real-time profiling with built-in delay rate ensures smooth graphics scene transitions and generation at a rate of 60 frames/second.

3.2.3.5.3 Head Mounted Display

The HMD, an Nvision nVisor SX device, provides stereoscopic images for the pilot and co-pilot. The nVisor SX consists of the following major components:

- nVisor SX HMD
- nVisor SX Control Box
- Universal Power Supply.

The nVisor SX HMD has dual ferroelectric liquid crystal on silicon displays (FLCOS). Each display has a 48° horizontal by 36° vertical FOV, with a 1280 x 1024 x 3 pixels with 100% overlap and 2.25 arc minutes/pixel, with a triad pixel structure, contrast ratio about 200:1, and weight of 0.964 kg. The HMD overall dimensions are 0.43 m (length) x 0.2 m (width) x 0.15 m (height).

The HMD will visually go blank momentarily at times when the software cannot update the visuals due to situations such as the motion platform engaging or the database loading.

The nVisor SX control box accepts two 60 Hz, non-interlaced input signals in super graphics adapter (SVGA) format and outputs to the display. The images are conveyed to the HMD by means of a Small Computer Standard Interface (SCSI) connector that runs from the nVisor SX Control Box that is in turn connected to the Video Distribution Subsystem with VGA video signal cables. The length of each VGA video signal cable is about 3 metres. The length of the SCSI cable is about 3 metres; it runs up from the centre of the motion base to the top of the seat for the pilot or from behind for the copilot.

The adjustable suspension system of the nVisor SX HMD consists of two bands at right angles to one another. A horizontal band surrounding the sides and back of the head allows the eyepieces to be tightened against the observer's brow with an adjustable ratchet. A vertical band that crosses from ear to ear allows the eyepieces to be raised or lowered to match the observer's line of sight.

Eye relief is adjusted by sliding adjustment knobs on each side of the nVisor SX HMD. These knobs can be used to move the AMLCD panels away from or toward the eyes. The eye relief is sufficiently large to allow the pilot to wear glasses. Optical alignment of the two images is accomplished by providing the pilot with an interior view of the Sea King helicopter and an exterior view of the ship's deck as it would appear from the helicopter when it is centred in the rapid securing device (RSD) and square with the ship. The pilot achieves binocular alignment of the images by alternately closing and opening each eye while looking forward and turning the inter-ocular adjustment knob so that a distant object appears centred to both.

3.2.3.6 Video Distribution Subsystem

The Video Distribution Subsystem accepts display images in VGA video signals from the Image Generator and distributes images to the HMD display and the Instructor Operator Station display. This is achieved through the use of commercial Video Splitters.

The 180 MHz RGB video bandwidth of this distribution amplifier makes it ideal for distributing RGB and Sync sources from PCs and workstations to three graphic projectors or display monitors.

The right eye Video Splitter accepts video signals in VGA format from the Simulation Computer via a low loss video cable and splits them into two outputs. The first output is interfaced with the HMD while the second output is sent to the Instructor Operator Station for display. The left eye Video Splitter accepts video signals in VGA format from the Simulation Computer via a low loss video cable and splits them into three outputs. The first output is interfaced with the HMD while the second output is sent to the Simulation Computer display monitor. The last output is provided to the Proxima DP6860 projector. The Instructor Operator Station eye Video Splitter accepts video signals in VGA format from the IOS Computer via a low loss video cable and splits them into two outputs. The first output is interfaced with the IOS display monitor while the second output is sent to the Proxima DP6860 projector for display.

3.2.3.7 Sound Subsystem

The Sound Subsystem delivers continuous auditory cues as a function of the Sea King's simulated flight regime based on analogue audio outputs received from the Sound Subsystem Control Computer. The cockpit sound is a digital reproduction of analogue recordings made on a Sea King flight during hover and cruising at 120 knots. Simple linear models determine the pitch and volume levels based on the helicopter control inputs and airspeed conditions. These models together with recommendations by the pilots are used to drive two sound channels to enhance the pilot's immersion in a virtual flight.

The Sound Subsystem consists of the following major components:

- Equipment Rack
- Yamaha DEQ7 Digital Equalizer
- BSS FDS-36O Integrated Frequency Dividing and Limiter
- Medium Frequency Amplifier - Carver TFM-6CB 200 Watt Amplifier
- Low Frequency Amplifier - McIntosh MC 2205 200 Watt Power Amplifier
- Medium Frequency Loudspeakers
- Low Frequency Loudspeakers.

Figure 3 shows the Sound and Vibration subsystem functional block diagram. Table 4 provides a summary of the Sound Subsystem physical and electrical specifications. The Sound Subsystem Control Computer drives the sound and vibration via an analogue output. It sends the audio signal to the Yamaha DEQ7 digital equalizer and BSS FDS36O frequency divider for shaping and separating the low frequency and mid-range audio signals with the 3 dB crossover set at approximately 80 Hz. The mid-frequency ranges are amplified by the Carver TFM-6CB 200 watt amplifier into DRDC-designed medium frequency loudspeakers, and the low frequency signals are fed to the low frequency loudspeakers.

Table 4 Sound Subsystem Physical and Electrical Specifications

Item	Power	Physical	Weight
Equipment Rack	N/A	1.42 m (H) x 0.52 m (W) x 0.64 m (D)	35 kg
Yamaha DEQ7	120 VAC, 30W	0.045 m (H) x 0.48 m (W) x 0.29 m (D)	3.7 kg
BSS FDS-360	110-220V, 50/60 Hz	0.044 m (H) x 0.482 m (W) x 0.228 m (D)	4.5 kg
Carver TFM-6CB	230 W at full power	0.03 m (H) x 0.48 m (W) x 0.32 m (D)	6.36 kg
McIntosh MC 2205	200W/channel, 400 W Mono	0.18 m (H) x 0.42 m (W) x 0.37 m (D)	38.6 kg
Medium Frequency Loudspeaker	N/A	0.46 m (H) x 0.36 m (W) x 0.21 m (D)	24 kg

Item	Power	Physical	Weight
Low Frequency Loudspeaker	N/A	1.22 m (H) x 0.8 m (W) x 1.22 m (D)	60 kg

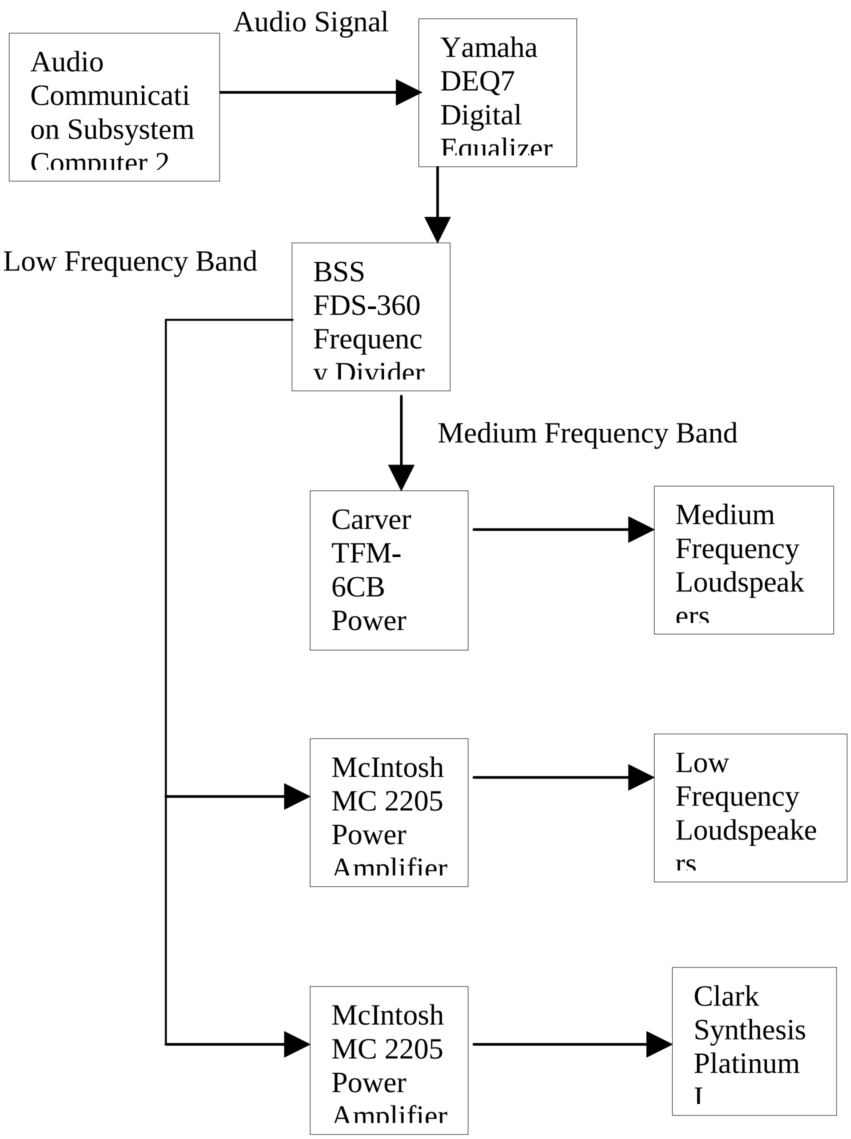

Figure 3 Sound and Vibration Subsystems Functional Block Diagram

The Yamaha DEQ7 Digital Equalizer employs the advanced Yamaha digital signal processing technology to provide precise, stable equalization in a wide variety of formats. There is a selection of graphic EQ types, parametric EQ, tone controls, band pass and band rejection filters, and a range of unique dynamic EQ programs. Any of the preset EQ programs can be edited and stored in any of 60 random access memory (RAM) locations for instant recall and use. The DEQ7 Digital Equalizer provides the following key features:

Graphic four band parametric tone control, band pass, band reject, notch filter and dynamic equalizer options

- Separate left and right settings or left = right
- Independent left and right time alignment delay and level on every programme
- Lock-out programme protection function.

The BSS FDS-360 Integrated Frequency Dividing and Limiter System is a stereo two-way or mono three or four-way fixed frequency fourth order crossover. The FDS-360 enables accurate control of loudspeaker power, dispersion and acoustical summation around the critical crossover region. It provides the following main features:

- Stereo two-way mode or switchable three/four-way mono mode
- Separate frequency band limiters matched to the precise band of frequencies controlled
- Separate polarity switching for each band
- LED signal level monitoring
- Band insertion points for interfacing external equalization and time delay units
- Band-edge phase adjustment allowing 360 degrees of control
- Crossover filter programming via plug-in frequency cards allowing any frequency, choice of 12/18/24 dB per octave slopes and filter responses to be specified. 24 dB/octave Linkwitz-Riley responses are provided as standard.
- Internal equalization option.

The Carver TFM-6CB provides loop-through outputs for “daisy-chaining” connection, input-level controls and a mono-mode. It provides the following major features:

- Two channel stereo or bridged mono switch
- All discrete circuitry throughout
- Left/right level controls
- A/B speaker selection
- Additional outputs for multiple amplifier connection.

The McIntosh MC2205 Stereo Power Amplifier provides the switching for two channel stereo or bridged mono.

3.2.3.8 Vibration Subsystem

Similar to the Sound Subsystem, the Vibration Subsystem provides continuous cues to supplement the motion systems. The Vibration Subsystem provides the higher frequency vibration environments (usually 3 to 20 Hz) that are not normally provided through platform motion systems. The Vibration Subsystem aids immersion into the synthetic environment by providing vibrations related to rotor blade functioning and speed conditions that the pilot could sense by no other means. The vibrations also serve to mask the unwanted stepping response characteristic of electric drives; a feature not normally present in large hydrostatic, hydraulic motion bases. Low pass outputs of the analogue recordings made on a Sea King helicopter flight during hover and cruising at 120 knots are used to drive the actuators and provide the vibration cues. Two types of actuators are used in this simulation; piezoelectric transducers attached to the pilot seat and large speakers.

The Vibration Subsystem consists of the following major components:

- McIntosh MC2205 200 Watt Power Amplifier
- Clark Synthesis Platinum I Transducers.

Table 5 Vibration Subsystem Physical and Electrical Specifications

Item	Power	Physical	Weight
McIntosh MC2205	200 W/channel, 400 W mono	0.18 m (H) x 0.42 m (W) x 0.37 m (D)	38.6 kg
Clark Synthesis Transducers	N/A	0.2 m (Diameter) x 0.06 m (Height)	0.77 kg

The Audio Communication Subsystem Computer 2 provides an analogue audio output to the primary Sound Subsystem. This primary simulation sound is frequency divided and shaped to provide two low frequency vibrating modes. One mode of low frequency vibration is provided by the McIntosh MC2205 200 watt power amplifier into the sub-woofers providing the roar of the engines and transmitted as vibration to the pilot's body environment. These bass reflex speakers are mounted approximately 2.4 m to the rear of the seat structure to provide full body environmental vibration. The second mode of low frequency vibration is provided by another McIntosh MC2205 200 watt power amplifier feeding two Clark Synthesis tactile sound transducers; one mounted midway up the back of the pilot seat lateral to the midline (approximately 0.36 m from the seating surface and 0.12 m off midline) and the second mounted on the underside of the seating surface (approximately 0.2 m. from the rear, in the midline).

3.2.3.9 Audio Communication Subsystem

The Audio Communication Subsystem provides the necessary audio communication interfaces between the pilot and the IOS operator. The IOS operator communicates directly with the pilot on an audio communication channel via a headset with an integrated microphone. While the IOS operator's headset is worn as an over-the-head-mounted device, the pilot's headset mounting is integrated with the Nvis HMD.

The Audio Communication Subsystem can provide either analogue voice or digital voice communication. The main analogue voice communication device is the Mackie 1202-VLZ PRO, which is a 12 channel compact mic/line mixer.

The digital Audio Communication Subsystem consists of the following items:

- Audio Communication Subsystem Computer 1 – Digital Audio Conferencing with a headset microphone
- Audio Communication Subsystem Computer 2 – Digital Audio Conferencing & Effects with a headset microphone.

The Audio Communication Subsystem Computer 2 – Digital Audio Conferencing & Effects is also used for sound generation. Each Audio Communication Subsystem Computer consists of the following major components:

- Audio Communication Subsystem Computer
- Display Monitor
- Keyboard
- Mouse.

The Audio Communication Subsystem Computer is a Dell Dimension 4100 desktop computer. The mid-size tower computer system is based on the Intel 815E chip set with support for 133 MHz memory, 4xAGP graphics, and Ultra ATA/100 hard drives. The basic Dimension 4100 computer is configured with a Pentium III/930 MHz CPU, 512 MB of DRAM, a 40 GB hard drive, 3.5 inch floppy disk drive, 48X CD-ROM drive, a 64 MB graphics card, and a sound card. However, an additional sound card and a 10/100BaseT network card are incorporated into the basic configuration to handle audio communication and audio network communication. The additional sound card is a Sound Blaster Live! Player 1024 card while the network card is an OEM 10/100 BaseT network card (Model 3C905CTX).

The display monitor, Model UltraScan P991, is a 19 inch colour display monitor. The keyboard, Model No. SK-8000, is a Dell Quiet Key standard keyboard. The pointing device is a Microsoft IntelliMouse, Part No. X04-721167.

3.2.3.10 Simulation Computer Subsystem

The Simulation Computer Subsystem executes the helicopter simulation management utilities, uses the pilot's controls to calculate the motion dynamics, determines the pilot's and co-pilot's point of view from tracking head movements, and generates the graphics scenario for the visual displays and the Instructor Operator Station repeater monitors. It also communicates with the IOS Computer, LSO Computer, Motion Platform Control Computer, Audio Communication Subsystem Computer 1 – Digital Audio Conferencing and Audio Communication Subsystem Computer 2 – Digital Audio Conferencing & Effects.

The Simulation Computer Subsystem is a Concurrent Imagen computer with 2 NVidia Quadro FX 5500 graphics cards.. The Concurrent Imagen running RedHawk Linux contains four dual-core AMD processor which execute the simulation management utilities. The Simulation Computer uses the outputs of the pilot's controls as inputs to drive the software simulating the flight dynamics and, together with prevailing environmental conditions, direct the movements to the Motion Platform Control Computer via the Ethernet connection.

The helicopter aerodynamics model developed by the University of Toronto Institute for Aerospace Studies (UTIAS) is used to simulate the aerodynamics of the Sea King. The Simulation Computer receives digital data from the primary flight controls, including the tail rotor pedals, collective pitch lever, and cyclic pitch stick for calculations of the flight and motion dynamics at update rates of 60 Hz. Platform motion dynamics are calculated and transmitted at this rate considering the primary flight data inputs in the aerodynamics model together with the environmental variables. Environmental variables include turbulent gust over the helicopter rotor disk, and air wake to represent aerodynamic disturbance around the ship.

The main loop of the simulation program operates at a rate of 60 Hz and directs the motion base playback vectors for rotations and translations of the motion base to simulate the Sea King flight dynamics. It also communicates the IOS, which is responsible for controlling the simulation.

The Simulation Computer Subsystem consists of the following major components:

- Uninterruptible Power Source (UPS)
- Simulation Computer
- Display Monitor
- Keyboard
- Mouse.

The UPS, a Matrix 5000 from American Power Conversion, is a high-power enhanced line interactive uninterruptible power source designed to provide clean, reliable AC power to the Simulation Computer.

The Simulation Computer, a Concurrent Imagen system, is a high-performance workstation. The Imagen workstation is equipped with the following standard features:

- Four dual-core AMD processors
- 16 Gigabytes of memory
- Two NVidia Quadro FX 5500

The Colour Graphics Monitor, Model No. GDM-4011P, is a 20 inch colour display monitor. The keyboard, Model No. U.S. AT-101 keyboard, is an industry-standard PS/2 style keyboard. The mouse is an industry-standard PS/2 style mouse.

3.2.3.11 Instructor Operator Station

The Instructor Operator Station communicates with the Simulation Computer Subsystem for the simulation control. In addition to the initiation and scheduled termination of the simulation, emergency stopping of the motion platform is available at the Instructor Operator Station. The IOS operator controls the simulation and simulation flow via the Instructor Operator Station's main display monitor. The main display monitor usually displays two views, operator’s view and pilot's view. The operator's view consists of a view of the simulation and selectable ship's heading, speed, and co-ordinates. The pilot’s view consists of heading, horizon, air speed, and altitude.

The IOS Computer Subsystem consists of the following major components:

- IOS Computer
- Display Monitor
- Keyboard
- Mouse
- Auxiliary Display Repeater.

The IOS Computer, a Dell workstation running RedHat Linux 8.0 is a high-performance workstation in a desktop enclosure

The colour graphics monitor, SGI Model No. CM2198MSG, is a 21 inch colour display monitor. The keyboard, SGI Model No. RT6856T, is an industry standard PS/2 style keyboard. The mouse, SGI Model No. M-S43, is an industry standard PS/2 style mouse. The Auxiliary Display Monitor, a Sony Trinitron Model Multiscan 17e, is a 17 inch display monitor.

3.2.3.12 Local Area Network

The Local Area Network (LAN) is achieved via Ethernet connections. It consists of the following major components:

Simulation LAN with communication hub and cable connections

The Simulation LAN is a 3 Com Office connect 10/100 hub 8 ports. The Simulation LAN provides communication among the five major computers (Motion Platform Control Computer, Simulation Computer, IOS Computer, LSO computer, Audio Subsystem Computer 1 – Digital Audio Cues and Audio Subsystem Computer 2 – Vibration and externalAudio Effects) that host the applications software for the simulation.

3.2.4 Computer Software Configuration Items

The simulator software consists of the following two major Computer Software Configuration Items (CSCI):

- Commercial Off-The-Shelf (COTS) CSCI
- HDLS-SMART CSCI.

3.2.4.1 Commercial Off The Shelf CSCI

The COTS CSCI, a collection of commercial software packages, consists of the following major Computer Software Components (CSCs):

- Purchased COTS CSC
- Freeware COTS CSC
- Custom COTS CSC.

NOTE

The device's total software architecture interrelates the functions of different software modules. The software tool that calculates the flight dynamics properties of the synthetic helicopter is developed and auto-coded in "MATRIXx". The software module that facilitates the motion/behaviour properties of the synthetic ocean and ship dynamics is called "Fredyn". The software module that facilitates the image generation is called "Performer". A software module called "Robust Audio Tool" or "RAT" facilitates the digital voice audio conferencing between "Federates" or "Roles" such as the Pilot, LSO and IOS operator. The software module that facilitates the ambient sound, such as engine noise, is called "OpenAL". Some other functions, such as the lighting sequencing of the synthetic Haul-down panel, have been enabled by software developed by DRDC Toronto and are incorporated within the device's total software architecture.

3.2.4.1.1 Purchased COTS CSC

The Purchased COTS CSC consists of the following major software packages:

- MS/DOS Operating System
- OpenGL Performer
- CerealBox Driver.

3.2.4.1.1.1 MS/DOS Operating System

The MS/DOS Operating System, version 6.22 from Microsoft, is a Disk Operating System (DOS) for personal computers. This operating system is applicable to the Motion Platform Control Computer.

3.2.4.1.1.2 OpenGL Performer for Linux

The OpenGL Performer for Linux Release 3.1.1 from SGI is a software development environment that supports programmers' implementation of high performance graphics applications. It offers both high level facilities for visual simulation and virtual reality tasks and an application-neutral high-performance hardware-oriented graphics toolkit. In the simulator, this software toolkit is used for creating real-time visual simulation and other 3D interactive graphics application. It provides the interface with advanced features to develop a sophisticated image generation system in a software environment.

3.2.4.1.1.3 CerealBox Driver

The CerealBox Driver from BG Systems provides the necessary functions to configure and interface with the CerealBox hardware.

3.2.4.1.2 Freeware COTS CSC

The Freeware COTS CSC consists of the following major components:

- Redhat 8.0 Linux Operating System
- High Level Architecture Run Time Infrastructure
- Parallel Virtual Machine

3.2.4.1.2.1 Linux Operating System

The Linux operating system with kernel, system software, and application software was originally developed for Intel x86-based PC's. The Linux Operating System release 8.0 from Red Hat is a Unix-like operating system for personal computers. This operating system is applicable to the LSO, IOS, Audio Communication Subsystem Computer 1 and Audio Communication Subsystem Computer 2.

3.2.4.1.2.2 High Level Architecture Run Time Infrastructure

The HLA Run-Time Infrastructure Next Generation 1.3 (RTI-NG 1.3) from Defence Modelling Simulation Organization (DMSO) is an implementation of the High Level Architecture Specification, version 1.3. The RTI provides a collection of common services used to support the modelling and simulation applications. All of these services are accessed through a standard application programming interface (API).

3.2.4.1.2.3 Parallel Virtual Machine

The Parallel Virtual Machine allows a computer to spawn processes on another computer.

3.2.4.1.3 Custom COTS CSC

The Custom COTS CSC consists of the following major components:

- Motion Platform Control Computer Software
- FREDYN
- Fast Light Tool Kit
- Fast Light User Interface Designer
- Open Audio Library

3.2.4.1.3.1 Motion Platform Control Computer Software

The Motion Platform Control Computer Software Package from Servos and Simulation, Inc. consists of the following major components:

- 3Com Ethernet Driver
- PC/TCP Kernel V4.1
- PC/TCP Kernel V4.1 Installation Software
- 6 DOF Source Code.

3.2.4.1.3.2 FREDYN

The FREDYN version 6.0 from Maritime Research Institute Netherlands (MARIN) is a computer program to simulate the motion behaviour of a steered, intact ship in moderate to extreme waves and wind. FREDYN consists of three main parts: CDAWSP, FREINP, and FREDYN. Table 6 provides a summary of these three programs.

Table 6 Summary of FREDYN Programs

Program Name	Descriptions
CDAWSP	Hull Geometry Definition - reads the American Standard Commission Information Interchange (ASCII) input file containing the hull geometry data and converts the station offsets to splines.

FREINP	Generation of Time-Independent Coefficients - determines the hydrodynamics coefficients for a given ship. These coefficients are stored on a data file, which serves as input file to FREDYN.
FREDYN	Time Domain Simulation - performs the time domain simulation of a steered ship in waves. The results can be stored in a data file and printed.

The FREDYN (simulation) program, which is normally running in the Simulation Computer, is used to model the CPF motion characteristics in the simulator.

3.2.4.1.3.3 Fast Light Tool Kit

The Fast Light Tool Kit (FLTK) is used to provide the necessary GUI for controlling the simulation exercise.

3.2.4.1.3.4 Fast Light User Interface Designer

The Fast Light User Interface Designer (FLUID) is a graphical editor that is used to produce FLTK source code. The FLUID editor can be used to edit and save its state in FLUID files.

3.2.4.1.3.5 Open Audio Library

The OpenAL from Loki Entertainment Software is an Application Programming Interface (API) for interactive, primarily spatialized audio.

3.2.4.2 HDLS-SMART CSCI

The HDLS-SMART CSCI consists of the following major items:

- Simulation Modelling Acquisition Rehearsal and Training (SMART) Application Software
- SMART Audio Video Data Base Software
- HDLS Application Software.

3.2.4.2.1 SMART Application Software

The SMART application software is a collection of hardware drivers and software utilities commonly required by simulation applications. It consists of the following software items:

- CerealBox Driver
- Motion Platform Driver
- Tracker Driver
- Audio Driver
- Dynamics
- Performer
- Graphics User Interface
- Multithreading
- Data Tree
- Network Interface Module (NIM)
- Socket
- Debug
- FileIO
- Utilities
- Filters
- Record
- Serial Port.

3.2.4.2.1.1 CerealBox Driver

The CerealBox Driver Library is an I/O interface to the CerealBox hardware device, allowing applications to collect analogue and digital data packets over a RS-232 serial link.

3.2.4.2.1.2 Motion Platform Driver

The Motion Platform Driver Library provides a driver for interfacing with six degrees of freedom motion platforms.

3.2.4.2.1.3 Tracker Driver

The Tracker Driver provides a common interface for communicating with various head movement tracking devices.

3.2.4.2.1.4 Audio Driver

The Audio Driver supports two distinct audio components: sound production and audio conferencing. Each component makes use of a client/server architecture. This allows the audio components to be distributed across a multi-platform network with clients running on high performance graphics workstations, while the server resides on a low cost PC (running Linux).

3.2.4.2.1.5 Dynamics

The dynamics model supports three different types of dynamics components: Helo Dynamics, Ship Dynamics, and Sea Dynamics. Each component handles a different type of movement characteristics.

The Helo Dynamics software provides the necessary interfaces to the Sea King helicopter flight dynamics model. The Ship Dynamics software provides the necessary interfaces to the Canadian Patrol Frigate (CPF) ship dynamics model. The Sea Dynamics software provides the necessary interfaces to the ocean wave model.

3.2.4.2.1.6 Performer

The Performer software provides the necessary interfaces to the SGI OpenGL Performer for Linux software package. The OpenGL Performer for Linux is a software package for managing and rendering real-time three-dimensional graphics.

3.2.4.2.1.7 Graphics User Interface

The graphical user interface software for SMART provides the necessary interfaces for the Fast Light Tool Kit (FLTK). The software is a collection of custom widgets and utilities that can be used to enhance the functionality of basic user interfaces.

3.2.4.2.1.8 Multithreading

The Multithreading package provides a consistent mechanism for handling multiple, concurrent tasks (processes) to ensure real time performance. It allows computationally intensive tasks running concurrently, removing bottlenecks and allowing for the maximum use of available computer resources.

3.2.4.2.1.9 Network Interface Module

The Network Interface Module (NIM) is a software package that has been developed by DRDC Toronto as an interface to the RTI, allowing SMART applications to make use of HLA without the tedium and complexity of dealing directly with the RTI.

3.2.4.2.1.10 Socket

The Socket package provides an interface for client/server socket communication through the sending and receiving of fixed size data packets.

3.2.4.2.1.11 Data Tree

The Data Tree package provides a hierarchical data type that can be read from and written to a file. This package is used to store all the simulation configuration data.

3.2.4.2.1.12 Debug

The Debug package provides a mechanism for flagging notable events and for filtering those events based on their level of severity during development and testing.

3.2.4.2.1.13 FileIO

The FileIO package is a simple utility for reading from and writing to a file.

3.2.4.2.1.14 Utilities

The Utilities package provides general-purpose software utilities and data types that are common to many applications.

3.2.4.2.1.15 Filters

The Filters package provides interfaces to a Kalman filter that is used to smooth out the velocity and acceleration.

3.2.4.2.1.16 Record

The Record package provides interfaces for record and playback.

3.2.4.2.1.17 Serial Port

The Serial Port package provides interfaces to communicate with a serial port.

3.2.4.2.2 SMART Audio Video Data Base Software (SAVDB)

The SMART Audio Video Data Base Software Package consists of the following major components:

- Model Interface
- Ocean Model Interface
- Sky Model Interface
- CPF Model Interface
- Sea King Helicopter Model Interfaces.
- Deck Crew Model Interface

Note that the synthetic models of LSO enclosure, helicopter, and ship deck are only approximations of the actual objects.

3.2.4.2.2.1 Model Interface

The Model Interface software package provides the necessary interfaces to the simulated models, which include the ocean, sky, CPF, and Sea King helicopter models.

3.2.4.2.2.2 Ocean Model Interface

The Ocean Model Interface software package provides the necessary interfaces to the simulated ocean and wave model.

3.2.4.2.2.3 Sky Model Interface

The Sky Model Interface software package provides the necessary interfaces to the simulated sky model.

3.2.4.2.2.4 CPF Model Interface

The CPF Model Interface software package provides the necessary interfaces to the simulated CPF three-dimensional graphical model.

3.2.4.2.2.5 Sea King Helicopter Model Interface

The Sea King Helicopter Model Interfaces software package provides the necessary interfaces to the Sea King helicopter three-dimensional graphical model.

3.2.4.2.2.6 Deck Crew Model Interface

The Deck Crew Model Interfaces software package provides the necessary interfaces to the Deck Crew three-dimensional graphical model.

3.2.4.2.3 HDLS Application Software

The HDLS Application software package consists of the following major components:

- Graphical User Interfaces
- Federates
- Session Manager
- Sources
- Control
- Views

- EntityDatabase
- Models
- Engines
- Clients
- Profiles
- Utilities
- Mains.

3.2.4.2.3.1 Graphical User Interface

The Graphical User Interface software package provides the necessary mechanisms for defining the user interface to control the simulation.

3.2.4.2.3.2 Federates

The Federates software package provides the necessary interfaces to encapsulate each participant in a federate.

3.2.4.2.3.3 Session Manager

The Session Manager provides the necessary interfaces for session controls within a scenario.

3.2.4.2.3.4 Sources

The Sources software package provides the necessary interfaces to handle multiple input data streams into a federate.

3.2.4.2.3.5 Controls

The Controls software package provides the necessary interfaces to handle the manipulation data stream.

3.2.4.2.3.6 Views

The Views software package provides the necessary interfaces to handle the output streams.

3.2.4.2.3.7 Entity Database

The Entity Database (or EntityDB) software package provides the federate and all of its components with full access to the contents of all entities. It is a static repository of all entities used by a federate.

3.2.4.2.3.8 Models

The Models software package provides the necessary interfaces to encapsulate the actual data within an entity.

3.2.4.2.3.9 Engines

The Engines software package provides the necessary interfaces to be used by the Control to manipulate the data within an entity.

3.2.4.2.3.10 Clients

The Clients software package provides the necessary interfaces for translating input from the various sources into a form the entity can understand, and then storing that information in the model.

3.2.4.2.3.11 Profiles

The Profiles software package provides the necessary interfaces for translating the contents of an entity by first extracting data from the model, and then converting data into a format understood by the view.

3.2.4.2.3.12 Mains

The Mains software package contains the top-level main routines for IOS Operator Control and Pilot Control.

3.2.5 Software Development Tools

Some of the non-deliverable software development tools include:

- MATRIXx
- MultiGen.

3.2.5.1 MATRIXx

The MATRIXx software tool from MathWorks is a family of products for real-time embedded control system applications. Table 7 provides a summary of five major components.

Table 7 MATRIXx Major Components

Component Name	Description
Xmath	System analysis and visualization environment. It contains over 700 predefined functions and commands, interactive colour graphics and a programmable graphical user interface.
SystemBuild	A graphical programming environment that uses a block diagramming paradigm with hierarchical structuring for modelling and simulation of linear and non-linear dynamics systems. It allows interactive model verification, testing and modification.
AutoCode	A code generation tool for processing SystemBuild model files to produce C or Ada code. The Autocode output can be compiled to produce the real-time flight simulation.
Documentlt	A documentation tool to create documentation from SystemBuild model files
Realsim	A simulation tool for performing real-time simulations of feedback control system models developed in SystemBuild

NOTE

MATRIXx uses a co-ordinate system called Earth Fixed Frame. Earth Fixed Frame assumes that the earth's horizon is flat. All horizontal, vertical and rotational data for a body in space, such as a synthetic helicopter, is based on its position from the Earth's Fixed Frame. The Earth Fixed Frame uses the standard scientific nomenclature of "X" for longitudinal axis, "Y" for the Lateral Axis, and "Z" for the vertical axis.

NOTE

The MATRIXx aerodynamic software module uses, for the synthetic helicopter, a single C of G position of 2.38 metres below the centre of the rotating rotor disc (on the longitudinal centre line of the airframe) or 2.34 metres above the extended wheels. Either of these two values equate to a single Z position within MATRIXx. The centre of the synthetic rotor disc is a point in space within MATRXx and must not be confused with the centre of the rotor hub of a real helicopter rotor system. Therefore, the calculations for C of G for a real helicopter airframe (that are reference to the airframe being level upon the earth's surface) do not equate to the C of G calculations made within MATRIXx.

NOTE

The C of G properties of the helicopter embodied within MATRIXx do change when a force is applied to the synthetic helicopter with a haul down cable.

NOTE

The value of torque displayed on the cockpit torque-meter is an approximation of a typical torque value for a CH124 operating at 16,600 lbs.

NOTE

The MATRIXx aerodynamic software module employs a value of 16,600 lbs for the flying weight of the synthetic helicopter. This value was selected based on a typical post sortie CH124 recovery while operating at the greatest fuel load that would facilitate using the haul down cable equipment at the maximum possible tension of 4,000 lb.

NOTE

The fuel level displayed on the cockpit's synthetic fuel gauges (4,000 lbs) plus a typical Basic Empty Weight (15,500 lbs) of a real CH124 is not consistent with the flying weight (16,600 lbs) for the virtual CH124. The synthetic CH124 operates in accordance with the parameters of the MATRIXx aerodynamic software module.

3.2.5.1.1 MultiGen Creator

The MultiGen Creator from MultiGen Paradigm is a software toolset for creating highly optimized, high fidelity real-time 3D database for use in visual simulation, interactive games, urban simulation, and other applications.

4 Maintenance

4.1 Introduction

The maintenance concept of the simulator is by unit replacement. This section consists of discussions on level one maintenance of the simulator. Procedures for system and unit maintenance are described in the following sections. The following areas will be covered:

- Preventive Maintenance
- Troubleshooting
- Corrective Maintenance.

4.1.1 Personnel and Skills Level

It is assumed that the simulator will be maintained by non-commissioned members of the Naval Electronic Technician (NE TECH) trades and Administration Clerk occupation. There are also civilian electronics technicians (EL-5 level) to assist with equipment maintenance. Technicians with mechanical skills are highly desirable to maintain the Motion Platform Subsystem.

4.2 Preventive Maintenance

4.2.1 Introduction

Regularly scheduled inspection should be performed to determine if equipment is clean, safe, and secure. Equipment cooling fans should be checked periodically to verify operation. Wiring harnesses and cables should be inspected for cuts, fraying, bends, loose connections, damaged shielding, and broken pins. Indicator lamps should be checked for burnouts or broken faces.

Preventive maintenance also includes computer administration that consists of file maintenance and upkeep and storage allocation.

WARNING

High voltages are present. Injury or death can occur if contact is made with high voltages. Turn power off before performing maintenance procedures.

4.2.2 Preventive Maintenance Schedule

The preventive maintenance schedule, as shown in Table 8, lists the scheduled maintenance procedures and intervals.

Table 8 Preventive Maintenance Schedule

Frequency	Maintenance Action
Bi-Monthly	Clean Motion Platform Subsystem Components and Filters, Flight Control Component Subsystem, and Electronics Cabinets/Enclosures.
Tri-Monthly	Perform Video Display Monitor/Focus Adjustments
Annually	Clean Air Filters
As Required	Clean IOS Display Monitors and Peripherals
	Clean Simulation Computer Subsystem Monitors and Peripherals
	Clean LSO Display Monitors and Peripherals
	Clean Sound Subsystem Monitors and Peripherals

4.2.3 Motion Platform Subsystem Inspection

The mechanical movements of the tail rotor pedals, pedal spring box, cyclic pitch stick, collective pitch lever, and pilot seat should be inspected and checked on a regular monthly basis for proper operations.

4.2.4 Equipment Cleaning

The following equipment requires scheduled cleaning:

- Simulation Computer
- IOS Computer
- LSO Computer
- Audio Subsystem Computer 1 – Digital Audio Cues
- Audio Subsystem Computer 2 – Vibration and Audio Effects
- Equipment Rack Station 1
- Equipment Rack Station 2
- Motion Platform Wooden Structure.

CAUTION

Do not use forced air to clean components as it may force dust or dirt into critical areas. Use care not to disturb wiring or components.

4.2.4.1 Simulation Computer

To keep the Simulation Computer free from dirt and dust, use a vacuum cleaner on the front and rear panels of the computer.

4.2.4.2 IOS Computer

To keep the IOS Computer free from dirt and dust, use a vacuum cleaner on the front and rear panels of the computer.

4.2.4.3 LSO Computer

To keep the IOS Computer free from dirt and dust, use a vacuum cleaner on the front and rear panels of the computer.

4.2.4.4 Audio Subsystem Computer 1

To keep the Audio Subsystem Computer 1 free from dirt and dust, use a vacuum cleaner on the front and rear panels of the computer.

4.2.4.5 Audio Subsystem Computer 2

To keep the Audio Subsystem Computer 2 free from dirt and dust, use a vacuum cleaner on the front and rear panels of the computer.

4.2.4.6 Equipment Rack Station1

To keep the Equipment Rack Station1 free from dirt and dust, use a vacuum cleaner on the front and rear panels of the Mackie 1202-VLZ PRO, Motion Platform Control Computer, Yamaha DEQ7 Digital Equalizer, BSS FDS-360 Integrated Frequency Dividing and Limiter, Carver TFM-6CB 200 Watt Amplifier and two McIntosh MC 2205 Amplifiers, both sides of the rack, and the power bar assembly inside the bottom.

4.2.4.7 Equipment Rack Station2

To keep the Equipment Rack Station2 free from dirt and dust, use a vacuum cleaner on the front and rear panels of the System Electronics Unit, Nvis Control Box, three Analogue Distribution Amplifiers, and CerealBox.

4.2.4.8 Motion Platform Wooden Structure

To keep the Motion Platform Wooden Structure free from dirt and dust, use a vacuum cleaner on the unit.

4.2.5 Air Filter Cleaning

The following units require regular cleaning of air filters:

- Motion Platform Wooden Structure
- Motion Platform Control Computer.

4.2.5.1 Motion Platform Wooden Structure Air Filter

The Motion Platform Wooden Structure protective screens must be removed before the air filters can be accessed. For each air filter, remove screws fastening the air filter plate to the Motion Platform Wooden Structure. Remove the protective screen and clean air filter with a vacuum cleaner. Remove the air filter and clean various components under the air filter with a vacuum cleaner. Reinstall the air filter by performing removal procedures in reverse.

4.2.5.2 Motion Platform Control Computer Air Filter

The Motion Platform Control Computer air filter must be cleaned on a regular basis. Open the front cover door of the Motion Platform Control Computer (Advantech Industrial Computer 610) by moving the key switch to the unlocked position and pulling the door open. Gain access to the air filter by gently pulling down the air filter assembly. Clean the air filter with warm water and mild soap. Dry and reinstall the air filter by performing removal procedures in reverse.

4.2.6 General Cleaning

The general cleaning procedures are applicable to the following units:

- Video Display Monitor
- Keyboard
- Mouse.

4.2.6.1 Video Display Monitor

Clean the cabinet, panel, and controls with a soft cloth lightly moistened with a mild detergent solution. Do not use any type of abrasive pad, scouring powder, or solvent such as alcohol or benzine.

4.2.6.2 Keyboard

Clean the keyboard with a vacuum cleaner when necessary.

4.2.6.3 Mouse

Clean the mouse by removing the ball and removing dust and dirt from the ball and rollers when necessary.

4.3 Troubleshooting

4.3.1 Introduction

The simulator contains monitoring software to perform a unit health check.

4.3.2 Hardware Device Status Monitoring

The simulator performs status monitoring on the following:

- Motion Platform Subsystem
- Head Tracking Device
- CerealBox Device
- Sound Subsystem
- Audio Communication Subsystem.

Refer to Section 4 of the HelMET Operator Manual [Reference h] for hardware status monitoring.

4.3.3 Operator Initiated Unit Tests

The simulator provides the following operator initiated unit tests:

- Motion Platform Subsystem
- Head Tracking Device
- CerealBox Device
- Sound Subsystem
- Audio Communication Subsystem.

Refer to Section 4 of the HelMET Operator Manual [Reference h] for operator initiated unit tests.

4.3.4 Manual Self Tests

Some of the components within the simulator possess self-test capabilities. The following paragraphs provide descriptions and instructions for individual line replacement units (LRUs).

4.3.4.1 Motion Platform Subsystem

For the Motion Platform Subsystem, refer to Section 4.0 of the Six Degree of Freedom Motion Platform Maintenance Manual [Reference k] for standalone testing.

4.3.4.1.1 Power Switch Box

Not applicable.

4.3.4.1.2 Power Control Panel

Not applicable.

4.3.4.1.3 Motion Platform Base Assembly

For the EMS Motor Drives, refer to the G5 Series General Purpose/Flux Vector Control Variable Frequency Drive Instruction Manual [Reference y] for diagnostics.

4.3.4.1.4 Motion Platform Control Computer

See 4.3.4.1.

4.3.4.1.5 Motion Platform Wooden Structure

Not applicable.

4.3.4.1.6 Platform Test Window

The Platform Test window, as shown in Figure 4, allows the maintainer to test the motion platform device for proper movements. The Platform Test window is started by entering platform_test at the Simulation Computer display terminal. The window provides the following functions as described in Table 9.

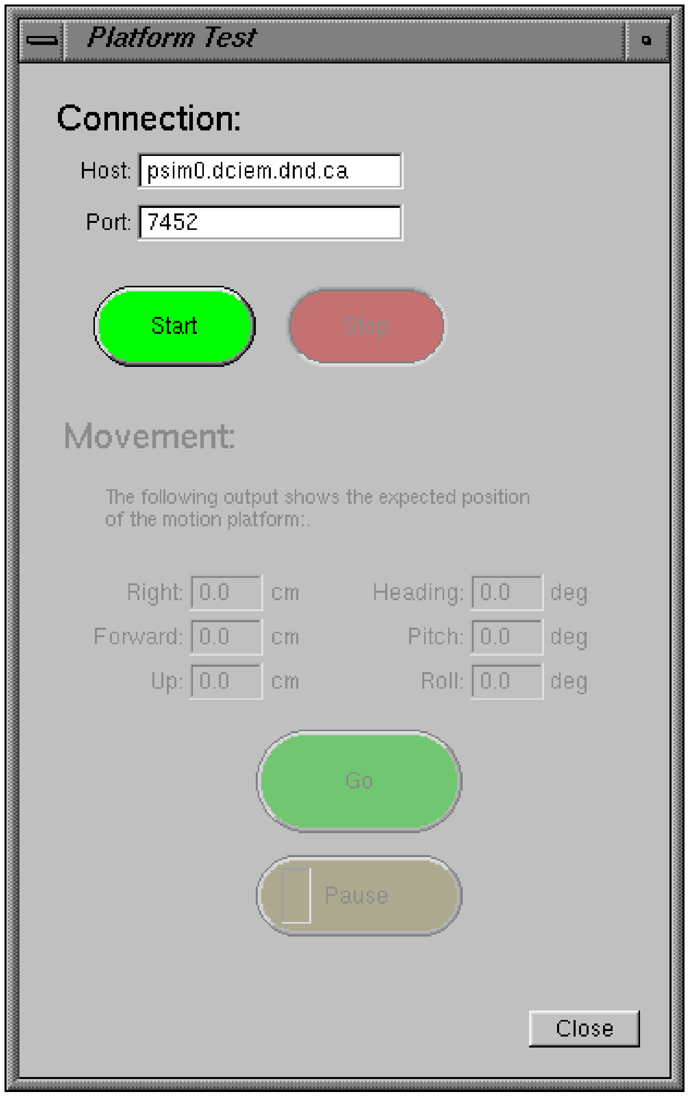

Figure 4 Platform Test Window

Table 9 Selection of Motion Platform Testing Functions

Entry	Definition
Motion Platform Control Computer Connection Statuses	
Host	The Host field is used to enter and display the Motion Platform Control Computer host name.
Port	The Port field is used to enter and display the Motion Platform Control Computer port number.
Motion Platform Movement Indicators	
Right	The Right field is used to define the amplitude value in the right direction. The default value is 0 cm.
Forward	The Forward field is used to define the amplitude value in the forward direction. The default value is 0 cm.
Up	The Up field is used to define the amplitude value in the up direction. The default value is 0 cm.
Heading	The Heading field is used to define the platform heading angle. The default angle is 0 degree.
Pitch	The Pitch field is used to define the platform pitch angle. The default angle is 0 degree.
Roll	The Roll field is used to define the platform roll angle. The default angle is 0 degree.
Motion Platform Testing Control Commands	
Start	The Start button is used to start the motion platform subsystem testing process.
Stop	The Stop button is used to stop the motion platform subsystem testing process.

Entry	Definition
Go	The Go button is used to initiate or resume the platform test pattern. To initiate the platform test pattern, the user must select the Start button and then the Go button. It will take several minutes to complete the platform test. The platform test pattern movements are: 5 inches in the forward position, 5 inches in the backward position, 5 inches in the left position, 4.5 inches in the up position, 4.5 inches in the down position, 18 degrees in the right yaw direction, 18 degrees in the left yaw direction, 18 degrees in the right roll direction, 18 degrees in the left roll direction, 18 degrees in the pitch forward direction, and 18 degrees in the pitch backward direction.
Pause	The Pause button is used to stop the platform testing process.
Window Action Control	
Close	The Close button is used to close the Platform Test window.

The following steps are used to test the motion platform:

- On the Platform Test window, click on the Start button to initiate the platform test.
- Click on the Go button to start the platform test.
- Verify the platform pre-defined movements (see the Go button description).
- Click on the Pause button to stop the platform movements.
- Click on the Go button to resume the platform movement.
- Verify the platform pre-defined movements.
- Click on the Pause button to stop the platform movements.
- Click on the Stop button to terminate the platform test.
- Click on the Close button to close the Platform Test window.

4.3.4.2 Flight Control Component Subsystem

4.3.4.2.1 Platform Table Assembly

Not applicable.

4.3.4.2.2 Collective Pitch Lever

For the Collective Pitch Lever unit test using the Flight Control window, refer to Section 4 of the HelMET Operator Manual [Reference h].

4.3.4.2.3 Cyclic Pitch Stick

For the Cyclic Pitch Stick unit test using the Flight Control window, refer to Section 4 of the HelMET Operator Manual [Reference h].

4.3.4.2.4 Tail Rotor Pedals

For the Tail Rotor Pedal unit test using the Flight Control window, refer to Section 4 of the HelMET Operator Manual [Reference h].

4.3.4.2.5 Pedal Spring Box

For the Pedal Spring Box unit test using the Flight Control window, refer to Section 4 of the HelMET Operator Manual [Reference h].

4.3.4.2.6 Pilot Seat

Not applicable.

4.3.4.2.7 CerealBox

For the CerealBox, refer to Chapter 4 of the CerealBox Hardware Manual [Reference l] and Chapter 7 of the LV824 Software Manual [Reference m] for troubleshooting.

For the CerealBox unit test using the Flight Control window, refer to Section 4 of the HelMET Operator Manual [Reference h].

4.3.4.2.8 CerealBox Helo Setup GUI Window

The CerealBox Helo Setup GUI Window, as shown in Figure 5, allows the maintainer to set and test the performance of the tail rotor pedals, collective pitch lever, cyclic pitch stick, and cyclic trim settings. An additional person is required to assist the maintainer to perform the CerealBox tests. The CerealBox GUI (Helo Setup) window is started by entering cerealbox_test at the Simulation Computer display terminal. Table 10 provides a summary of the user selections to test the following:

- Test the left and right tail rotor pedals movements
- Test the collective pitch lever movements
- Test the cyclic pitch stick movements
- Test the helicopter trim release, weapon, Auto Stab, ICS, Radio and Probe controls of the cyclic pitch stick buttons.

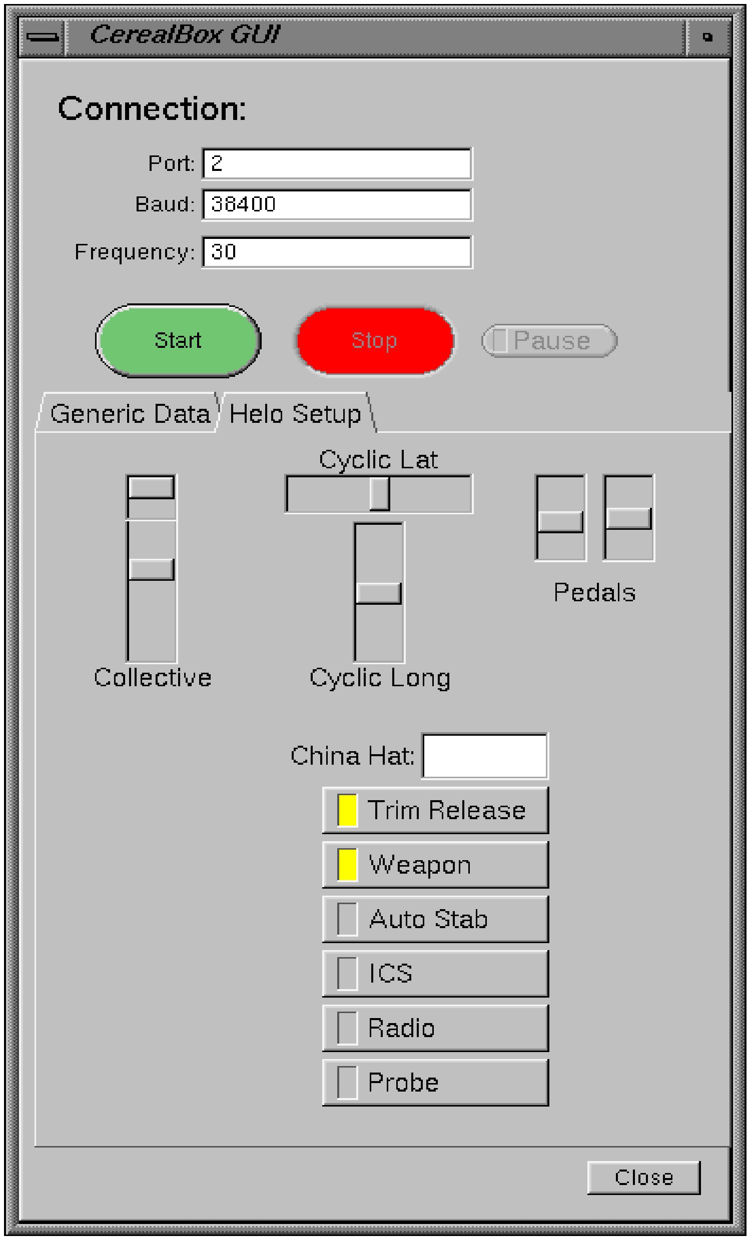

Figure 5 CerealBox Helo Setup GUI Window

Table 10 Selection of CerealBox Helo Set Up Testing Functions

Entry	Definition
CerealBox Connection Statuses	
Port	The Port field is used to enter and display the PC host port number
Baud	The Baud field is used to enter and display the PC host serial port speed value.
Frequency	The Frequency field is used to enter the update frequency in Hz of the CerealBox device. The default value is 30 times per second.
CerealBox Testing Control Commands	
Start	The Start button is used to start the CerealBox device testing process. The user must move each control in each of its ranges of movement and activate all buttons on the cyclic pitch stick, then verify the results displayed at the CerealBox GUI window.
Stop	The Stop button is used to stop the CerealBox device testing process.
Pause	The Pause button is used to toggle the CerealBox device testing process to a pause state. The reselection of this button is to resume the testing process.
Flight Control Display Indicators	
Collective	The Collective switch is used to test the collective pitch lever movements. The user must physically move the Collective Pitch Lever in the up or down directions and observe the movement displayed at the CerealBox GUI window.
Cyclic Lat	The Cyclic Lat switch is used to set the cyclic pitch stick lateral movements. The user must physically move the Cyclic Pitch Stick in the lateral directions and observe the movement displayed at the CerealBox GUI window.
Cyclic Long	The Cyclic Long switch is used to set the cyclic pitch stick longitudinal movements. The user must physically move the Cyclic Pitch Stick in the longitudinal directions and observe the movement displayed at the CerealBox GUI window.

Entry	Definition
Pedals	The pedals switches are used to set the left and right pedal movements. The user must physically move the left or right tail rotor pedals in the forward or backward directions and observe the movement displayed at the CerealBox GUI window.
China Hat	The China Hat field is used to display the cyclic trim position. The valid positions are up, down, left and right and they are mutually exclusive. The user must physically activate the trim buttons and observe the appropriate selection displayed at the CerealBox GUI window.
Flight Control Statuses	
Trim Release	The Trim Release button is used to permit momentary release of the stick position for repositioning. The user must physically activate the Trim Release button and observe the selection displayed at the CerealBox GUI window.
Weapon	The Weapon button is used to select release of selected stores. The user must physically activate the Weapon button and observe the selection displayed at the CerealBox GUI window.
Auto Stab	The Auto Stab button is used to disengage the Automatic Stabilization Equipment. The user must physically activate the Auto Stab button and observe the selection displayed at the CerealBox GUI window.
ICS	The ICS button is used to enable the Inter-Communication System for crew communication. The user must physically activate the ICS button and observe the selection displayed at the CerealBox GUI window.
Radio	The Radio button is used to enable radio transmissions outside of helicopter. The user must physically activate the Radio button and observe the selection displayed at the CerealBox GUI window.
Probe	The Probe button is used to select release of the probe. The user must physically activate the Probe button and observe the selection displayed at the CerealBox GUI window.
Window Action Control	
Close	The Close button is used to close the CerealBox GUI window.

The following steps are used to test the CerealBox interfaces:

- On the CerealBox Helo Setup GUI window, click on the Start button to initiate the CerealBox Interface test.
- Move the Collective Pitch Stick and observe the collective display value.
- Move the Cyclic Pitch Stick in the lateral direction and observe the Cyclic Lat display value.
- Move the Cyclic Pitch Stick in the longitudinal direction and observe the Cyclic Long display value.
- Move the left tail rotor pedal and observe the left pedal display value.
- Move the right tail rotor pedal and observe the right pedal display value.
- Move the Trim movement button and observe the China Hat display value.
- Depress the Trim Release button and observe the Trim Release button display value.
- Depress the Weapon button and observe the Weapon button display value.
- Depress the Auto Stab button and observe the Auto Stab button display value.
- Depress the ICS button and observe the ICS button display value.
- Depress the Radio button and observe the Radio button display value.
- Depress the Probe button and observe the Probe button display value.
- Click on the Stop button to terminate the CerealBox Interface test.
- Click on the Close button to close the CerealBox Helo Setup GUI window.

4.3.4.2.9 CerealBox Generic Data GUI Window

The CerealBox Generic Data GUI window, as shown in Figure 6, allows the advanced user to set and test the general analogue and digital data for the CerealBox device. An additional person is required to assist the maintainer to perform the CerealBox tests. The CerealBox GUI window is started by entering cerealbox_test at the Simulation Computer display terminal. The window provides the following selections as described in Table 11.

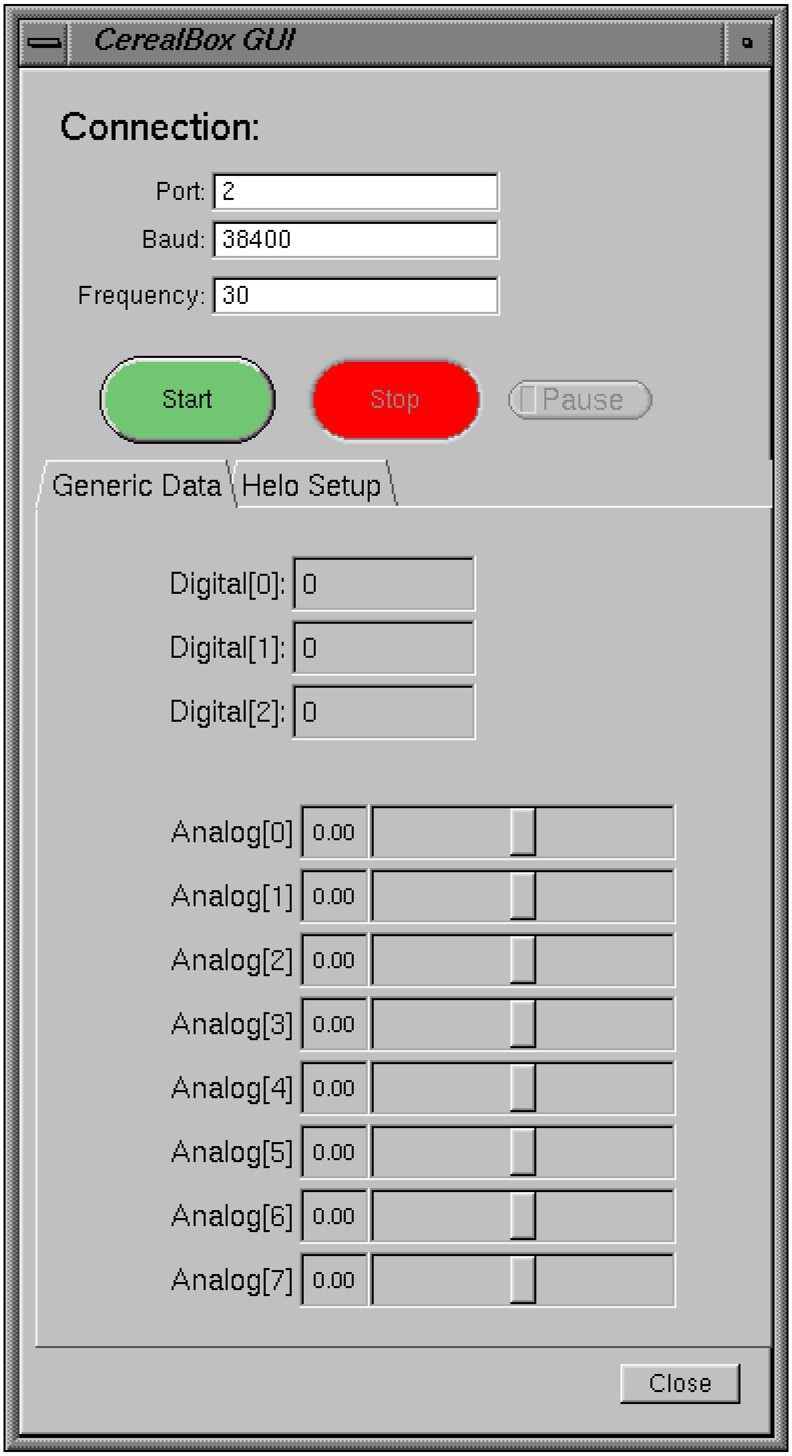

Figure 6 CerealBox Generic Data GUI Window

Table 11 Selection of CerealBox Generic Data Testing Functions

Entry	Definition
CerealBox Connection Statuses	
Port	The Port field is used to enter and display the PC host port number
Baud	The Baud field is used to enter and display the PC host serial port speed value.
Frequency	The Frequency field is used to enter the update frequency in Hz of the CerealBox device. The default value is 30 times per second.
CerealBox Testing Control Commands	
Start	The Start button is used to start the CerealBox device testing process.
Stop	The Stop button is used to stop the CerealBox device testing process.
Pause	The Pause button is used to toggle the CerealBox device testing process to a pause state. The reselection of this button is to resume the testing process.
CerealBox Digital Display Indicators	
Digital [0]	The Digital [0] field is used to display the Cyclic Pitch Stick discrete values. Bit 0 = Weapon, Bit 1 = Hat Up, Bit 2 = Hat Right, Bit 3 = Hat Left, Bit 4 = Hat Down, Bit 5 = Trim Release, Bit 6 = Probe, and Bit 7 = Auto Stab. The user must physically activate the trim buttons and observe the appropriate selection displayed at the CerealBox GUI window.
Digital [1]	The Digital [1] field is used to display the Cyclic Pitch Stick discrete values. Bit 0 = Radio and Bit 1 = ICS. The user must physically activate the Radio and/or ICS buttons and observe the appropriate selection displayed at the CerealBox GUI window.
Digital [2]	Not used.
CerealBox Analogue Display Indicators	
Analog [0]	Not used.

Entry	Definition
Analog [1]	Not used.
Analog [2]	Not used.
Analog [3]	Not used.
Analog [4]	The Analog [4] field is used to display the Cyclic Pitch Stick lateral position. The user must physically move the Cyclic Pitch Stick in the lateral directions and observe the movement displayed at the CerealBox GUI window.
Analog [5]	The Analog [5] field is used to display the Cyclic Pitch Stick longitudinal position. The user must physically move the Cyclic Pitch Stick in the longitudinal directions and observe the movement displayed at the CerealBox GUI window.
Analog [6]	The Analog [6] field is used to display the Tail Rotor Pedal position. The user must physically move the left or right tail rotor pedals in the forward or backward directions and observe the movement displayed at the CerealBox GUI window.
Analog [7]	The Analog [7] field is used to display the Collective Pitch Lever position. The user must physically move the Collective Pitch Lever in the up or down directions and observe the movement displayed at the CerealBox GUI window.
Window Action Control	
Close	The Close button is used to close the CerealBox GUI window.

The following steps are used to test the CerealBox interfaces:

- On the CerealBox Generic Data GUI window, click on the Start button to initiate the CerealBox Interface test.
- Move the Collective Pitch Stick and observe the Analog [7] display value.
- Move the Cyclic Pitch Stick in the lateral direction and observe the Analog [4] display value.
- Move the Cyclic Pitch Stick in the longitudinal direction and observe the Analog [5] display value.
- Move the left tail rotor pedal and observe the Analog [6] display value.

- Move the right tail rotor pedal and observe the Analog [6] display value.
- Move the Trim movement button and observe the Digital [0] display value.
- Depress the Trim Release button and observe the Digital [0] display value.
- Depress the Weapon button and observe the Digital [0] display value.
- Depress the Auto Stab button and observe the Digital [0] display value.
- Depress the ICS button and observe the Digital [1] display value.
- Depress the Radio button and observe the Digital [1] display value.
- Depress the Probe button and observe the Digital [0] display value.
- Click on the Stop button to terminate the CerealBox Interface test.
- Click on the Close button to close the CerealBox Generic Data GUI window.
-

4.3.4.3 Visual Subsystem

4.3.4.3.1 Head Tracking Device

For the 3 SPACE FASTRAK System Electronics Unit, refer to Section 5.4 of the 3 SPACE FASTRAK User's Manual [Reference n] for testing.

4.3.4.3.2 Image Generator

See Section .

4.3.4.3.3 Nvision SX Head Mounted Display

For the Nvision Head Mounted Display, refer to the Troubleshooting section of the User Guide [Reference o].

4.3.4.3.4 Tracker GUI Window

The Tracker GUI window, as shown in Figure 7, allows the maintainer to set, connect and control the head tracker device for testing. An additional user is required to assist the maintainer to conduct the tracker test. The Tracker GUI window is started by entering tracker_test at the Simulation Computer display terminal. The window provides the following selections as described in .

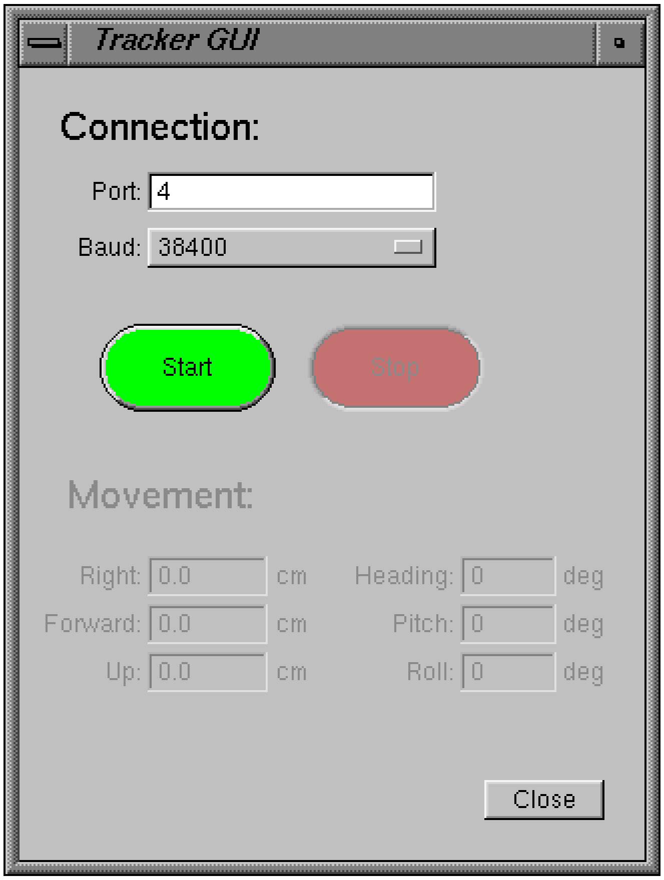

Figure 7 Tracker GUI Window

Table 12 Selection of Head Tracker Device Testing Functions

Entry	Definition
Tracker Connection Statuses	
Port	The Port field is used to display and enter the PC host port number
Baud	The Baud field is used to display and enter the PC host serial port speed value in baud rate.

Entry	Definition
Tracker Testing Control Commands	
Start	The Start button is used to start the head tracker device testing process. The user must physically move the HMD and observe the movement result displayed at the Tracker GUI window.
Stop	The Stop button is used to stop the head tracker device testing process.
Tracker Movement Indicators	
Right	The Right field is used to display the right offset value in centimeters. The user must physically move the HMD in the right direction and verify the displayed right value. Small fluctuations in the displayed value may be observed.
Forward	The Forward field is used to display the forward offset value in centimeters. The user must physically move the HMD in the forward direction and verify the displayed forward value. Small fluctuations in the displayed value may be observed.
Up	The Up field is used to display the up offset value in centimeters. The user must physically move the HMD in the up direction and verify the displayed up value. Small fluctuations in the displayed value may be observed.
Heading	The Heading field is used to display the heading angle value in degrees. The user must physically move the HMD in the heading direction and verify the displayed angle. Small fluctuations in the displayed value may be observed.
Pitch	The Pitch field is used to display the pitch angle value in degrees. The user must physically move the HMD in the pitch direction and verify the displayed angle. Small fluctuations in the displayed value may be observed.
Roll	The Roll field is used to display the roll angle value in degrees. The user must physically move the HMD in the roll direction and verify the displayed angle. Small fluctuations in the displayed value may be observed.
Window Action Control	
Close	The Close button is used to close the tracker GUI window.

The following steps are used to test the head tracker movements:

- On the Tracker GUI window, click on the Start button to initiate the head tracker test.
- Move the head tracker in the Right direction and observe the display value.
- Move the head tracker in the Forward direction and observe the display value.
- Move the head tracker in the Up direction and observe the display value.
- Move the head tracker in the Heading direction and observe the display value.
- Move the head tracker in the Pitch direction and observe the display value.
- Move the head tracker in the Roll direction and observe the display value.
- Click on the Stop button to terminate the head tracker test.
- Click on the Close button to close the Tracker GUI window.

4.3.4.4 Video Distribution Subsystem

4.3.4.4.1 Proxima DP 6860 Projector

Not applicable.

4.3.4.5 Sound Subsystem

4.3.4.5.1 Yamaha DEQ7 Digital Equalizer

Not applicable.

4.3.4.5.2 BSS FDS-360 Integrated Frequency Dividing and Limiter

Not applicable.

4.3.4.5.3 Craver TFM-6CB Power Amplifier

For the TFM-6CB Power Amplifier, refer to the HELP! A Troubleshooting Guide section of the Carver TFM-6C High-Headroom/Low-Feedback Power Amplifier Owner's Manual [Reference r].

4.3.4.5.4 McIntosh MC 2205 Power Amplifier

Not applicable.

4.3.4.5.5 Medium Frequency Loudspeakers

Not applicable.

4.3.4.5.6 Low Frequency Loudspeakers

Not applicable.

4.3.4.6 Vibration Subsystem

4.3.4.6.1 McIntosh MC 2205 Power Amplifier

Not applicable.

4.3.4.6.2 Clark Synthesis Sound Transducers

For the Clark Synthesis Tactile Sound Transducer, refer to the Quick Trouble Shooting section of the Clark Synthesis Tactile Sound Installation and Operation Guide [Reference s].

4.3.4.7 Audio Communication Subsystem

4.3.4.7.1 1202-VLZ PRO 12-Channel Mic/Line Mixer

For the 1202-VLZ PRO 12-Channel Mic/Line Mixer, refer to Section 54 of the 1202-VLZ PRO 12-Channel Mic/Line Mixer Owner's Manual [Reference aa].

4.3.4.7.2 Dell Dimension 4100 Computer

For the Dell Dimension 4100 Computer, refer to the System Codes and Messages section of the Dell Dimension 4100 System Reference [Reference w].

4.3.4.7.3 UltraScan P991 Video Display Monitor

For the UltraScan P991 Video Display Monitor, refer to the Troubleshooting Tips section of the Dell UltraScan P991 Colour Monitor Quick Setup [Reference x] for diagnostics.

4.3.4.7.4 Keyboard

For the keyboard, refer to the System Codes and Messages section of the Dell Dimension 4100 System Reference [Reference w].

4.3.4.7.5 Mouse

Not applicable.

4.3.4.8 Simulation Computer Subsystem

4.3.4.8.1 Matrix UPS 5000

For the UPS, refer to Chapter 7 of the Matrix UPS User's Manual [Reference z] for troubleshooting.

4.3.4.8.2 Concurrent Imagen Workstation

For the Simulation Computer Subsystem, refer to the Tyan B4985 Transport FT48 Service Engineers Manual Barebone System [Reference cc] and the Tyan S4985 Thunder n4250QE User's Manual [Reference dd] for basic troubleshooting.

4.3.4.8.3 GDM-4011P Colour Graphic Monitor

For the GDM-4011P Colour Graphic Monitor, refer to the Troubleshooting section of the GDM-4011P Colour Graphic Monitor Operating Instructions [Reference t].

4.3.4.8.4 Keyboard

Not applicable.

4.3.4.8.5 Mouse

Not applicable.

4.3.4.9 Instructor Operator Station Subsystem

4.3.4.9.1 Dell Precision 530

For the Instructor Operator Station Computer Subsystem computer, refer the Dell Precision Workstation 530 Service Manual [Reference gg] for basic troubleshooting.

4.3.4.9.2 CM2198MSG Colour Monitor

Not applicable.

4.3.4.9.3 Keyboard

Not applicable.

4.3.4.9.4 Mouse

Not applicable.

4.3.4.9.5 GDM-17SE1 Colour Graphic Monitor

For the GDM-17SE1 Colour Graphic Monitor, refer to the Troubleshooting section of the Multiscan 17se Colour Graphic Monitor Operating Instructions [Reference v]. The following procedures are used to perform a monitor self-test:

- Press the Power button to turn the monitor off
- Disconnect the monitor video cable from the Video Distribution Subsystem
- Press the Power button to turn the monitor on
- Simultaneously press and hold the CTRL and POWER buttons for 3 seconds
- The monitor should display a white screen to indicate that it is operating correctly.

4.3.4.10 Landing Signals Officer Subsystem

4.3.4.10.1 Dell Precision 650

For the Instructor Operator Station Computer Subsystem computer, refer the Dell Precision Workstation 650 Service Manual [Reference ff] for basic troubleshooting.

4.3.4.10.2 CM2198MSG Colour Monitor

Not applicable.

4.3.4.10.3 Keyboard

Not applicable.

4.3.4.10.4 Mouse

Not applicable.

4.3.4.10.5 GDM-17SE1 Colour Graphic Monitor

For the GDM-17SE1 Colour Graphic Monitor, refer to the Troubleshooting section of the Multiscan 17se Colour Graphic Monitor Operating Instructions [Reference v]. The following procedures are used to perform a monitor self-test:

- Press the Power button to turn the monitor off
- Disconnect the monitor video cable from the Video Distribution Subsystem
- Press the Power button to turn the monitor on
- Simultaneously press and hold the CTRL and POWER buttons for 3 seconds
- The monitor should display a white screen to indicate that it is operating correctly.

4.3.4.11 Local Area Network

4.3.4.11.1 3 Com Office Connect 10/100 Hub

Not applicable.

4.4 Corrective Maintenance

Corrective maintenance is required when a fault is detected on one or more LRUs within the simulator. The first and second line of support usually consists of removal and replacement of the defective part. Third level support consists of repair at the contractor's or manufacturer's facilities.

4.4.1 Mean Time To Repair Figures

The Mean Time To Repair (MTTR) figures, as shown in Table 13, contain a list of LRUs and their MTTR.

Table 13 Simulator Mean Time To Repair Figures

Line Replacement Unit	Mean Time To Repair (Hrs)
Motion Platform Subsystem	
Power Switch Box	N/A
Power Control Panel	N/A
Motion Platform Base Assembly	N/A
Motion Platform Computer	0.5
TTX-3402Display Monitor	0.25
Keyboard	0.25
Motion Platform Wooden Structure	N/A
Flight Control Component Subsystem	
Platform Table Assembly	N/A
Collective Pitch Lever	2.0
Cyclic Pitch Stick	2.0
Tail Rotor Pedals	2.0
Tail Rotor Pedal Spring Unit	1.0
Pilot Seat	2.0
CerealBox	0.5
Visual Subsystem	

Line Replacement Unit	Mean Time To Repair (Hrs)
3 SPACE FASTRAK II Transmitter	1.0
3 SPACE FASTRAK II Receiver	1.0
3 SPACE FASTRAK II System Electronics Unit	0.5
NVIS Head Mounted Display	2.5
NVIS Control Box	0.5
Video Distribution Subsystem	
ADA 3 180 MX	0.5
Proxima DP6860 Projector	2.0
Sound Subsystem	
Equipment Rack1	N/A
Yamaha DEQ7	0.5
BSS FDS-360	0.5
Carver TFM-6CB	0.5
McIntosh MC 2205	0.5
Medium Frequency Loudspeaker	0.5
Low Frequency Loudspeaker	0.5
Vibration Subsystem	
McIntosh MC 2205	0.5

Line Replacement Unit	Mean Time To Repair (Hrs)
Clark Synthesis Transducer	1.0
Audio Subsystem	
Mackie 1202 VLZ PRO	0.75
Dell Dimension 4100 Audio Communication Computer	0.5
UltraScan P991	0.25
Keyboard	0.25
Mouse	0.25
Simulation Computer Subsystem	
Matrix UPS 5000	2.0
Concurrent Imagen Computer	1.0
GDM-4011P Colour Graphics Monitor	0.25
Keyboard	0.25
Mouse	0.25
Instructor Operator Station	
Dell Precision Workstation 530	1.0
CM2198MSG Colour Graphics Monitor	0.25
Keyboard	0.25
Mouse	0.25

Line Replacement Unit	Mean Time To Repair (Hrs)
Multiscan 17se Colour Display Monitor	0.25
Landing Signals Officer	
Dell Precision Workstation 650	Dell Precision Workstation 650
CM2198MSG Colour Graphics Monitor	CM2198MSG Colour Graphics Monitor
Keyboard	Keyboard
Mouse	Mouse
Multiscan 17se Colour Display Monitor	Multiscan 17se Colour Display Monitor
Local Area Network	
3 Com Office Connect 10/100 Hub	1.0

4.4.2 Support Equipment

A list of support equipment and standard tools that may be required is discussed in Section .

WARNING

High voltages are present. Injury or death can occur if contact is made with high voltages. Turn power off before performing maintenance procedures.

CAUTION

Ensure that Maintainer protects components from electrostatic discharge with grounded strap before touching equipment.

4.4.3 Simulator Subsystem Corrective Maintenance

4.4.3.1 Motion Platform Subsystem

For the Motion Platform Subsystem, refer to Sections 2.0 and 3.0 of the Six Degree of Freedom Motion Platform Maintenance Manual [Reference k] for corrective maintenance.

4.4.3.1.1 Power Switch Box

Not applicable.

4.4.3.1.2 Power Control Panel

For the Power Control Panel (also known as the Electrical Power Distribution and Control Enclosure), refer to Section 2.0 of the Six Degree of Freedom Motion Platform Maintenance Manual [Reference k] for corrective maintenance.

4.4.3.1.3 Motion Platform Base Assembly

For the Motion Platform Subsystem, refer to Sections 3.0 of the Six Degree of Freedom Motion Platform Maintenance Manual [Reference k] for corrective maintenance.

4.4.3.1.4 Motion Platform Control Computer

For the Motion Platform Subsystem, refer to Section 2.0 of the Six Degree of Freedom Motion Platform Maintenance Manual [Reference k] for corrective maintenance.

4.4.3.2 Flight Control Component Subsystem

4.4.3.2.1 Platform Table Assembly

Not applicable.

4.4.3.2.2 Collective Pitch Lever

Not applicable.

4.4.3.2.3 Cyclic Pitch Stick

Not applicable.

4.4.3.2.4 Tail Rotor Pedals

Not applicable.

4.4.3.2.5 Pilot Seat

Not applicable.

4.4.3.2.6 Flight Control CerealBox

For the CerealBox, refer to Chapter 2 of the CerealBox Hardware Manual [Reference l] and Chapter 7 of the LV824 Software Manual [Reference m] for installation and corrective maintenance.

4.4.3.3 3Visual Subsystem

4.4.3.3.1 Head Tracking Device

For the 3 SPACE FASTRAK System Electronics Unit, refer to Section 5.0 of the 3 SPACE FASTRAK User's Manual [Reference n] for installation.

4.4.3.3.2 Image Generator

Not applicable.

4.4.3.3.3 NVISION SX Head Mounted Display

For the NVISION SX Head Mounted Display, refer to the Section 2 of the NVISION SX User Guide [Reference o] for installation.

4.4.3.4 Video Distribution Subsystem

4.4.3.4.1 Video Splitter

See applicable manual.

4.4.3.4.2 Proxima DP6860 Projector

Not applicable.

4.4.3.5 Sound Subsystem

4.4.3.5.1 Yamaha DEQ7 Digital Equalizer

For the Yamaha DEQ7 Digital Equalizer, refer to the Controls & Connections section of Yamaha Digital Equalizer Operating Manual [Reference p] for installation.

4.4.3.5.2 BSS FDS-360 Integrated Frequency Dividing and Limiter

For the BSS FDS-360 Integrated Frequency Dividing and Limiter, refer to the Connections And Controls Descriptions section of the FDS 360 User's Manual [Reference q] for installation.

4.4.3.5.3 TFM-6CB Power Amplifier

For the TFM-6CB Power Amplifier, refer to the Hook-Up section of the Carver TFM-6C High-Headroom/Low-Feedback Power Amplifier Owner's Manual [Reference r] for installation.

4.4.3.5.4 McIntosh MC 2205 Power Amplifier

Not applicable.

4.4.3.5.5 Medium Frequency Loudspeakers

Not applicable.

4.4.3.5.6 Low Frequency Loudspeakers

Not applicable.

4.4.3.6 Vibration Subsystem

4.4.3.6.1 McIntosh MC 2205 Power Amplifier

Not applicable.

4.4.3.6.2 Clark Synthesis Sound Transducers

For the Clark Synthesis Tactile Sound Transducer, refer to the appropriate sections of the Clark Synthesis Tactile Sound Installation and Operation Guide [Reference s] for installation.

4.4.3.7 Audio Communication Subsystem

4.4.3.7.1 1202-VLZ PRO 12-Channel Mic/Line Mixer

For the 1202-VLZ PRO 12-Channel Mic/Line Mixer, refer to Section 2 of the 1202-VLZ PRO 12-Channel Mic/Line Mixer Owner's Manual [Reference aa] for installation.

4.4.3.7.2 Dell Dimension 4100 Computer

For the Dell Dimension 4100 Computer, refer to the Removing and Replacing Parts section of the Dell Dimension 4100 System Reference [Reference w].

4.4.3.7.3 UltraScan P991 Video Display Monitor

For the UltraScan P991 Video Display Monitor, refer to the Connecting Your Monitor to a Computer and Driver Installation sections of the Dell UltraScan P991 Color Monitor Quick Setup [Reference x] for installation.

4.4.3.7.4 Keyboard

Not applicable.

4.4.3.7.5 Mouse

Not applicable.

4.4.3.8 Simulation Computer Subsystem

4.4.3.8.1 Matrix UPS 5000

For the UPS, refer to Chapters 4 and 7 of the Matrix UPS User's Manual [Reference z] for installation and maintenance respectively.

4.4.3.8.2 Concurrent Imagen Workstation

For the Simulation Computer Subsystem, refer to Tyan B4985 Transport FT48 Service Engineers Manual Barebone System [Reference cc] and the Tyan S4985 Thunder n4250QE User's Manual [Reference dd] for corrective maintenance.

4.4.3.8.3 GDM-4011P Colour Graphic Monitor

For the GDM-4011P Colour Graphic Monitor, refer to the Getting Started section of the GDM-4011P Colour Graphic Monitor Operating Instructions [Reference t] for corrective maintenance.

4.4.3.8.4 Keyboard

Not applicable.

4.4.3.8.5 Mouse

Not applicable.

4.4.3.9 Instructor Operator Station Subsystem

4.4.3.9.1 Dell Precision 530 PC

For the Instructor Operator Station Computer Subsystem computer, refer to the Dell Precision 530 Service Manual [Reference hh] for corrective maintenance.

4.4.3.9.2 CM2198MSG Colour Monitor

For the CM2198MSG Colour Graphic Monitor, refer to the Installation section of the CM2198MSG Graphic Monitor User’s Manual [Reference u] for installation.

4.4.3.9.3 Keyboard

Not applicable.

4.4.3.9.4 Mouse

Not applicable.

4.4.3.9.5 GDM-17SE1 Colour Graphic Monitor

For the GDM-17SE1 Colour Graphic Monitor, refer to the Getting Started section of the Multiscan 17se Colour Graphic Monitor Operating Instructions [Reference v] for installation.

4.4.3.10 Landing Signals Officer Station Subsystem

4.4.3.10.1 Dell Precision 650 PC

For the Landing signals Officer Station Computer Subsystem computer, refer to the Dell Precision 650 Service Manual [Reference ff] for corrective maintenance.

4.4.3.10.2 CM2198MSG Colour Monitor

For the CM2198MSG Colour Graphic Monitor, refer to the Installation section of the CM2198MSG Graphic Monitor User’s Manual [Reference u] for installation.

4.4.3.10.3 Keyboard

Not applicable.

4.4.3.10.4 Mouse

Not applicable.

4.4.3.10.5 GDM-17SE1 Colour Graphic Monitor

For the GDM-17SE1 Colour Graphic Monitor, refer to the Getting Started section of the Multiscan 17se Colour Graphic Monitor Operating Instructions [Reference v] for installation.

4.4.3.11 Local Area Network

4.4.3.11.1 Com Office Connect 10/100 Hub

For the 3 Com Office Connect 10/100 Hub, the operating system network communication commands (e.g. ‘ping’ command) can be used to verify the installation.

5 Support and Test Equipment

5.1 General

The following sections address tools and test equipment to support scheduled and corrective maintenance.

5.2 Basic Support and Test Equipment

The following test equipment will be necessary to support the simulator for the majority of all anticipated fault conditions.

- Standard Computer Technicians' Tool Kit
- Digital Multimeter.

5.3 Manual Diagnostic Test Equipment

The following additional test equipment could be required if a particular obscure fault were to arise that could not be isolated by the diagnostics.

- Digital Oscilloscope
- Logic Analyzer.

5.4 Motion Platform Subsystem Required Tools

For the Motion Platform Subsystem required tools, refer to Section 3 of the Six Degree of Freedom Motion Platform Maintenance Manual [Reference k].

6 Unit Configuration Settings

6.1 General

These sections address jumper and switch settings and Ethernet addresses that are specific to the simulator configuration.

6.2 Jumper and Switch Settings

6.2.1 Motion Platform Control Computer

For the Motion Platform Control Computer switch settings, refer to Section 2 of the Six Degree of Freedom Motion Platform Maintenance Manual [Reference k].

6.2.2 3 SPACE FASTRAK II System Electronics Unit

The 3 SPACE FASTRAK II System Electronics Unit switch settings are shown in Table 14.

Table 14 System Electronics Unit Switch Settings

SEU Switches	Switch On Status
CTS 206-4	1234: 0111
CTS 206-8	12345678: 10101001

6.2.3 Audio Communication Subsystem Computer 1

For the Dell Dimension 4100 Computer system board configuration jumper, Pins 1-2 are jumpered (Normal Mode).

6.2.4 Audio Communication Subsystem Computer 2

For the Dell Dimension 4100 Computer system board configuration jumper, Pins 1-2 are jumpered (Normal Mode).

6.2.5 Simulation Computer

Not applicable.

6.2.6 IOS Computer

Not applicable.

6.3 Ethernet Address Settings

Unique Ethernet settings apply to the following computers:

- Motion Platform Control Computer
- Audio Subsystem Computer 1
- Audio Subsystem Computer 2
- Simulation Computer
- IOS Computer.

The Ethernet settings for those computers are shown in Table 15.

Table 15 Simulator Computer Ethernet Address Settings

Computer Name	Ethernet Address	
Motion Platform Control Computer	131.136.68.205	psim0
Audio Subsystem Computer 1	131.136.68.215	pcsim40
Audio Subsystem Computer 2	131.136.68.173	pcsim42
Simulation Computer	131.136.68.60	sim14
IOS Computer	131.136.68.40	pcios
LSO Computer	131.136.68.31	pclso

7 Notes

7.1 Abbreviations and Acronyms

Item	Descriptions
AC	Alternating Current
ADA	Analogue Distribution Amplifier
AMLCD	Active Matrix Liquid Crystal Display
API	Application Programming Interface
ASCII	American Standard Commission Information Exchange
C	Centigrade (or Celsius)
CD-ROM	Compact Disk Read Only Memory
CF	Canadian Forces
CFB	Canadian Forces Base
CFTO	Canadian Forces Technical Order
cm	Centimetre
COTS	Commercial Off-The-Shelf
CPF	Canadian Patrol Frigate
CPU	Central Processing Unit

Item	Descriptions
CSC	Computer Software Component
CSCI	Computer Software Configuration Item
DAC	Digital to Analogue Converter
dB	Decibel
Dias	The operator or person controlling the simulator.
DMSO	Defense Modelling Simulation Organization
DoD	Department of Defense
DOF	Degrees of Freedom
DOS	Disk Operating System
DRAM	Dynamic Random Access Memory
DRDC	Defence R&D Canada
FLTK	Fast Light Tool Kit
FLUID	Fast Light User Interface Designer
FOV	Field of View
GB	Gigabytes

Item	Descriptions
GUI	Graphical User Interface
HDL	Helicopter Deck Landing
HDLS	Helicopter Deck Landing Simulator
HelMET	Helicopter Maritime Environment Trainer
HLA	High Level Architecture
HMD	Head Mounted Display
HUD	Head Up Display
HWCI	Hardware Configuration Item
Hz	Hertz
I/O	Input/Output
ICS	Inter-Communication System
IOS	Instructor Operator Station
IP	Internet Protocol
LAN	Local Area Network
LED	Light Emitting Diode

Item	Descriptions
LOD	Level of Detail
LRU	Line Replacement Unit
LSO	Landing Signal Officer
M	metre
MB	Megabytes
mic	microphone
MHz	Mega Hertz
MM	Maintenance Manual
MS/DOS	MicroSoft Disk Operating System
MTTR	Mean Time To Repair
N/A	Not Applicable
NIM	Network Interface Module
nmi	Nautical Miles
OEM	Original Equipment Manufacturer
OM	Operator Manual

Item	Descriptions
OSD	Operational Sequence Diagram
PC	Personal Computer
PROM	Programmable Read Only Memory
PVM	Parallel Virtual Machine
RAM	Random Access Memory
RAT	Robust Audio Tool
RGB	Red Green Blue
RHS	Reconfigurable Helicopter Simulator
RMS	Root Mean Squared
RSD	Recovery Securing Device
RTI	Run Time Infrastructure
SBC	Single Board Computer
SCSI	Small Computer Standard Interface
SEU	System Electronics Unit
SGI	Silicon Graphics Inc.

Item	Descriptions
SHOP	Shipborne Helicopter Operating Procedures
SMART	Simulation Modelling Acquisition Rehearsal and Training
STD	Software Test Description
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol/Internet Protocol
UPS	Uninterruptible Power Source
UTIAS	University of Toronto Institute for Aerospace Studies
VAC	Voltage Alternating Current
VDC	Voltage Direct Current
VDD	Version Description Document
VGA	Video Graphics Adapter
VLP	Virtual Lesson Plan
VR	Virtual Reality
VR-Sim	Virtual Reconfigurable Simulator

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Simulateur d'entraînement virtuel pour hélicoptère maritime : Manuel d'entretien : (U)

4. AUTHORS (First name, middle initial and last name. If military, show rank, e.g. Maj. John E. Doe.)

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(U) The Helicopter Maritime Environment Trainer (HelMET) was developed by Defence R&D Canada – Toronto (DRDC Toronto) for training helicopter pilots to land on the flight deck of a Canadian Patrol Frigate (CPF) in a virtual environment. The HelMET was installed at 12 Wing, Canadian Forces Base (CFB) Shearwater, Nova Scotia, Canada [reference: Summary per document cited in next paragraph].

DRDC Toronto Document: CR2002−028 Atlantis Document: ED997−00369 titled Helicopter Maritime Environment Trainer: Maintenance Manual documented Version 1.1 of the HelMET System.

As third party support for the HelMET system did not come to fruition, DRDC Toronto has been supporting the HelMET system at 12th Wing Shearwater with hardware and software updates. The current version of HelMET is Version 4.4. Many of the updates implemented were made to allow the simulator to be used as a procedures trainer.

This document is a revision of CR2002−028 updated to reflect the large number of changes that have been implemented by DRDC Toronto since version 1.1. The purpose of this document is to update the description so that the system can be maintained and operated by Director Aerospace Development Program Management, Radar and Communications Systems or its representatives.

(U) Le Simulateur d’entraînement virtuel pour hélicoptère maritime (HelMET) a été développé par Recherche et développement pour la défense Canada – Toronto (RDDC Toronto) afin d’entraîner les pilotes d’hélicoptère à l’atterrissage sur le pont d’envol d’une frégate canadienne de patrouille dans un environnement virtuel. Le système HelMET a été installé à la 12e Escadre, Base des Forces canadiennes Shearwater, Nouvelle Écosse, Canada [référence : sommaire par document cité dans le paragraphe suivant].

Document RDDC Toronto : CR2002 028, document Atlantis : ED997 00369 intitulé Simulateur d’entraînement virtuel pour hélicoptère maritime : Manuel d’entretien, documentation de la version 1.1 du logiciel HelMET.

Étant donné que la prise en charge du système HelMET par un tiers ne s’est pas réalisée, c’est RDDC Toronto qui en assure, par conséquent, le soutien à la 12e Escadre Shearwater au moyen de mises à niveau de matériel et de mises à jour de logiciel. La dernière version du logiciel HelMET est la version 4.4. De nombreuses fonctionnalités qui ont été implémentées visaient à permettre au simulateur d’être utilisé comme système d’entraînement aux procédures.

Le présent document est une révision du document CR2002 028 dont la mise à jour vise à refléter le grand nombre de modifications apportées au logiciel par RDDC Toronto depuis la version 1.1. L’objectif de ce document est de mettre à jour les descriptions de façon à ce que le système puisse être maintenu et utilisé par le Directeur – Gestion du programme de développement aérospatial (système de radar et de communication) ou ses représentants.

14. KEYWORDS, DESCRIPTORS or IDENTIFIERS (Technically meaningful terms or short phrases that characterize a document and could be helpful in cataloguing the document. They should be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location may also be included. If possible keywords should be selected from a published thesaurus, e.g. Thesaurus of Engineering and Scientific Terms (TEST) and that thesaurus identified. If it is not possible to select indexing terms which are Unclassified, the classification of each should be indicated as with the title.)

(U) Virtual Reality Simulator; Team Trainer; Deck Landing; Sea King; CPF; Frigate; LSO; Landing Signals Officer; Part−task Trainer